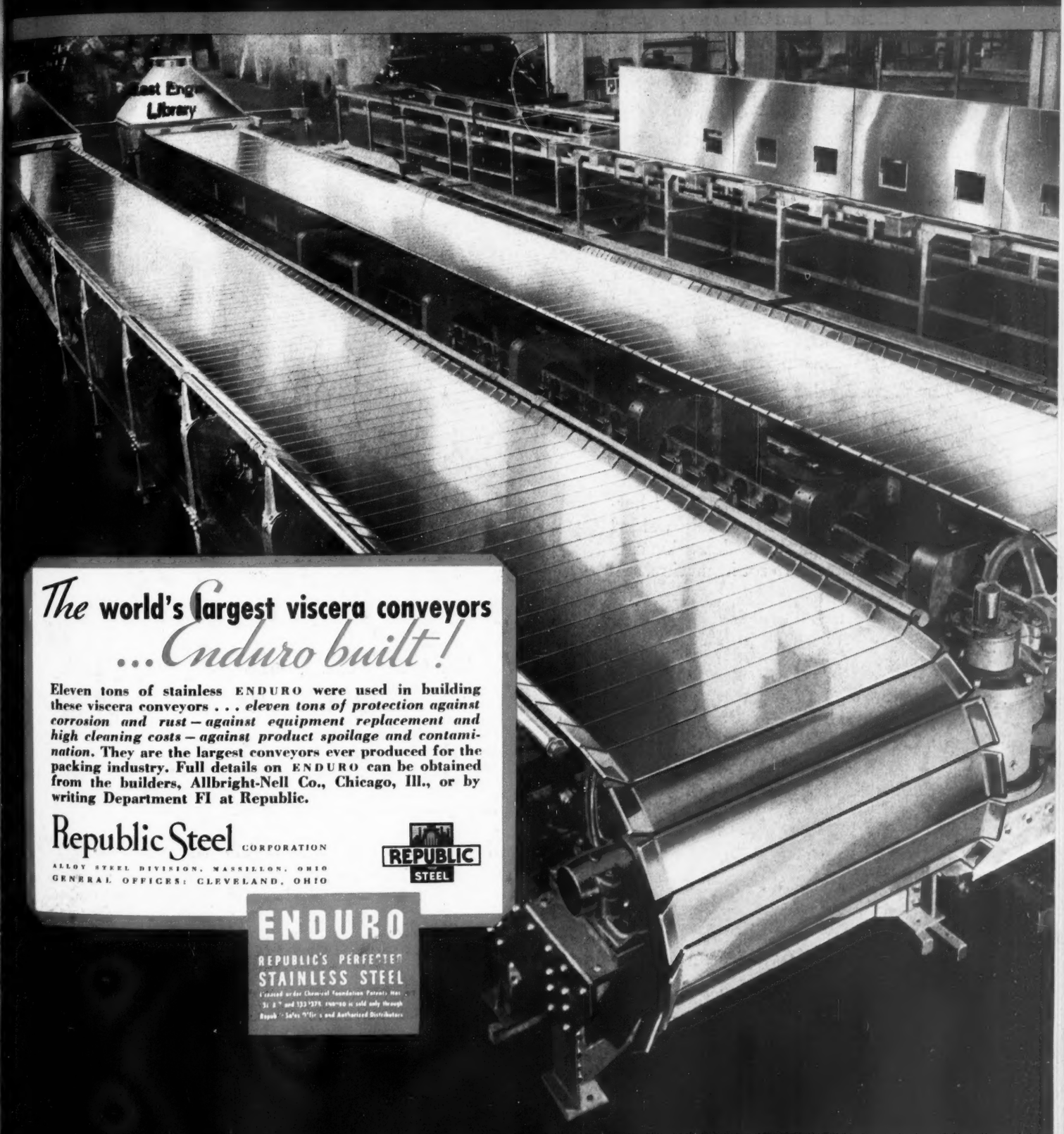
FOOD INDUSTRIES

JUN 8 1936



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JUNE, 1936

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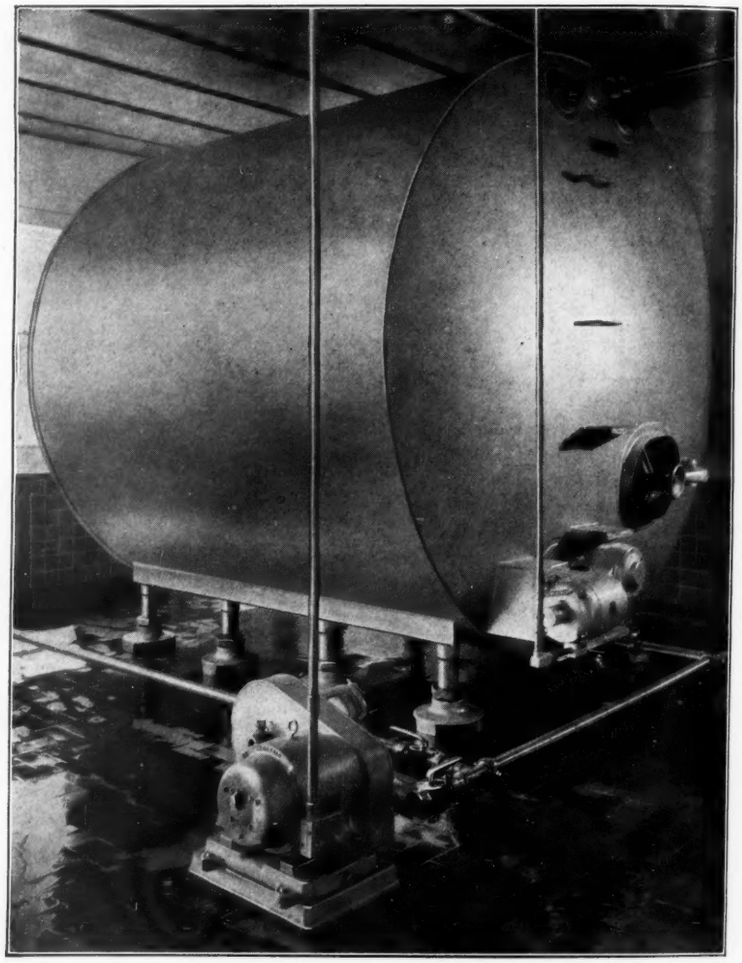

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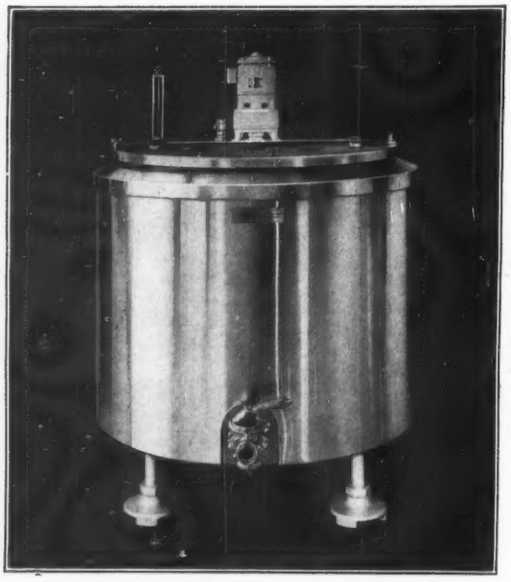

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Contents for June, 1936

Volume 8, Number 6

Controlled Atmospheres Number

Why Controlled Atmospheres Are Important to You 269

Controlled Atmosphere Applications in the Food Industries 271

How Industrial Air Conditioning Operates in the Food Field *By Walter Jones* 272

Rate of Air Movement of Vital Importance *By Vernon Cano* 275

Food Manufacturers' Responsibility Before Operating Under Air Conditioning *By W. C. Culver and George Garnatz* 276

Equipment for Air Conditioning 279

Enzymes and the Storage of Perishables *By E. F. Kohman* 287

Atmospheric Factors Affecting the Storage and Handling of Fresh Fruits and Vegetables *By D. F. Fisher* 289

Treating Fruits and Nuts in Atmospheres Containing Ethylene 292
By E. M. Chace and D. G. Sorber

Mold and Bacteria Killed by New Lamp *By R. F. James* 295

Company Gets Better Plant Location *By F. H. Leonhardt* 298

Cutting Production Costs by Controlled Cooling *By E. N. Hershey* 299

Adapting Transportation Units to Pre-Cooling 301

Modern Air Cooling Units Conserve Fish Storage Space 303

Air Conditioning Benefits Small Meat Packer 304

Bakery Air Conditioning *By W. W. Reece* 305

Control of Odors and Molds by Ozone and Ionized Oxygen 307

Humidity Control for Hard Candy 308

Gas Storage of Meats 309

Manufacturers of Air Conditioning Equipment 311

Departments

Notes and Comment 267

The Plant Notebook 313

Automotive Section 315

New Equipment 316

Catalogs 317

Business Trends 318

News 319

Company Activities 321

Personals 322

Book Notes 324

Patents 324

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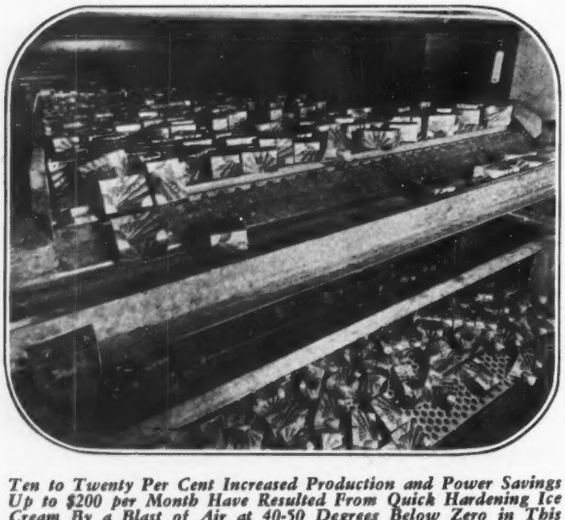

Ten to Twenty Per Cent Increased Production and Power Savings Up to $200 per Month Have Resulted From Quick Hardening Ice Cream By a Blast of Air at 40-50 Degrees Below Zero in This Tunnel at the Hershey Creamery Company, Harrisburg, Penna.

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Established 1928—McGraw-Hill Publishing Company, Inc.

Vol. 8, No. 6

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Laurence V. Burton, Editor

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JUNE 1936

CONTROLLED ATMOSPHERES NUMBER

Notes and Comment

WHEN you read this entire issue you will not learn how to design an installation to control the atmosphere in your plant, but you will learn what such control will do for you, how to recognize your needs for a controlled atmosphere and how it will perform for you after it has once been put under control.

Equipment for any but the simplest jobs of controlling should be tailor-made to fit the needs of a given job. The equipment makers' engineers can tell you what you will need to perform a job, but it is up to the food manufacturer to decide pretty definitely what he wants done.

IONIZED AIR NOTE: We don't want to boast, but we have recently been to Harvard for a three-hour course of special instruction on ionized air from Professor C. P. Yaglou. To prove his point that air can be ionized without simultaneously producing ozone, he caused us to lie on a bed in a special room where he turned on enough electricity to generate be-

tween nine and ten million ions per ccm. in the air. One could draw a one-inch spark from any part of our recumbent anatomy as long as we were insulated by the bedding, but no ozone could be smelled.

Though Professor Yaglou will not admit any casual relationship, we afterwards observed an irresistible desire to talk loquaciously and to drive the car through red traffic lights. In fact, the feeling of exhilaration which we experienced leads us to believe that we ought to have an ionizing machine in our home the next time we have a party that shows signs of going sour.

SOCIETY NOTE: A few days ago we accepted an invitation to "cocktails between 5 and 7" in a penthouse atop a mid-town New York

tower to meet a celebrity who, we have it on good authority, is soon to do much in the way of popularizing one of the items in our daily diet. Having spent most of our life in small towns, our previous knowledge of penthouses has been derived solely from the movies. Though apprehensive of running into a murder or Jean Harlow or something, we resolutely went through the ordeal. And, you will be relieved to know, we made only a few very serious blunders which, in a manner of speaking, is doing right well for a novice.

Only a fleeting glimpse of the said celebrity could we gain, but we had a most entertaining chat with the caterer, who explained how he figures the cost of big parties.

LIKE dog food? All the recent blah about folks eating canned dog food is more than a year late. It may be good campaign material, which we doubt, but the fact is that FOOD INDUSTRIES first commented on the new market for charcoal in dog food to reduce its eye appeal on page 105, March, 1935.

Ethylene Pickles?

AFTER discussing with E. M. Chase of the U. S. Department of Agriculture, the uses of ethylene in the processing of English walnuts to get the husks off more easily, the idea occurred to us that perhaps ethylene might have some use in the pickle business.

Every year there is a mad rush to be the first to get the new dill pickles on the market, and often brine pickles have to wait until the following spring until the cure is complete before they can be "finished."

If ethylene has the function of speeding up normal life processes, might it not be worth an experiment to determine what it will do in hastening the curing of dills and salt "pix"? It might be possible to cure them in a much shorter time, or at a higher salt concentration with consequently stronger and more enduring physical structure. Even sauerkraut might be cured much more rapidly in this way.

Our idea would be to experiment

in a small way by slowly bubbling ethylene gas through the pickle brine as soon as the cucumbers are put down. But use pure gas, and for the love of Mike, don't try any one thousand-bushel tanks for the first experiment! Try it out in a small way until you have some idea what is going to happen. It might prove to be utterly worthless.

On the other hand, it might succeed admirably, and then think of the merchandising possibilities. There is all the possibility of capitalizing on oil company publicity for Ethyl Gas by calling our new pickles "Ethyl Pickles."

Sensible Heat vs. Latent Heat

MANY articles in this issue of FOOD INDUSTRIES mention sensible heat and latent heat. To get the most from your reading it is important to understand the difference between the two.

Sensible heat refers to the heat that can be felt by the senses. The term has no connection whatever with wisdom, or good judgment or common sense. Sensible heat can be measured by a thermometer.

Latent heat, on the other hand, cannot be measured directly by the thermometer. If any substance changes from a solid to a liquid, or a liquid to a vapor, or solid to a vapor, it absorbs heat during the change of state, but the temperature does not rise until after all of the substance has been changed. If there is no temperature rise, then there is nothing that can be felt by the senses and there is nothing that can be measured directly by a thermometer. In other words there is no change of sensible heat, yet careful experiments have proved that heat has been absorbed. This heat is called latent heat. When the reverse takes place and vapors are condensed to liquids or liquids frozen to solids, the same amount of heat is given off that was absorbed during the corresponding change of state and it is still called latent heat.

Our bodies are kept cool by the latent heat of evaporation of water, principally from our lungs but also to a smaller extent from the skin.

To illustrate the two forms of heat by an easy example, consider the following: If the moisture is removed from a quantity of air by an absorbent such as silica gel, the latent heat of condensation of water is given off and the temperature rises correspondingly, even though no other heat source is applied to the air. The latent heat has become sensible heat. If now the dry air is sprayed with water at the same temperature as the air, some of the water will evaporate and latent heat will be absorbed causing the temperature to fall. In this case sensible heat is converted back into latent heat.

Both aspects of heat are present in any atmosphere that contains moisture. Their sum is called the total heat. Readers of FOOD INDUSTRIES do not have need to be air-conditioning engineers but they need to understand the basic principles.

Get Rid of Non-Sterile Sawdust

WHILE we are discussing controlled atmospheres, it is time to give vent to our periodic squawk about sawdust on the floors of meat coolers and cold storage rooms.

American meat handlers can well afford to take a lesson from the best English practice on this point. Because of England's great distance from the origin of most of its supplies of meats, it is necessary to exert every possible precaution to make the meat keep. And the English meat handler is well aware of the hazard of dust contamination.

On the other hand, in America, we still sprinkle sawdust liberally on the floors and hope for the best while scuffing it about as we walk through the rooms. Only the much shorter marketing period prevailing in the United States permits this practice to continue. It is really nothing short of sheer luck.

It is strange that no other adequate absorbent has been discovered for this purpose, or why someone has never tried sterilizing the sawdust in a high temperature dryer.

Let's Be Sensible About This

NO doubt the zealots who are plugging for the clause in the Copeland Bill, to revise the food and drug law, which will require the label of a food to list all of the ingredients when no standard has been promulgated for that food, will be greatly pleased by a recent paper by Dr. Walter Alverez of the Mayo Clinic. He told the American Gastro-Enterological Association about cases of narcolepsis (abnormal drowsiness), canker sores, hayfever, and digestive troubles caused by sensitiveness to certain specific foods. Even the cream in one man's morning coffee has caused him to fall asleep at about 11 o'clock every day regardless of where he might be.

Apparently the majority of persons are more or less sensitive to some substance. And if one reads "Allergy," by Dr. Warren T. Vaughn, it will be found that the list of responsible or causative substances goes way beyond foods to take in wool, feathers, cat-hairs, dog-hairs, dust, leather, a host of drugs, pollens, glue, tobacco, etc., the number of the total running into hundreds of items. Furthermore, every known spice is on the list.

Uninformed or biased zealots see only the foods that are responsible. They forget or ignore all other substances. If only foods were responsible for allergies probably we would pull in our horns and agree that for the good of the unfortunates, the labels should disclose the ingredients and when we say ingredients we mean every single one of them, including the spices. And we would not exempt any food regardless of whether the Food and Drug Administration has promulgated standards therefor that were acceptable to the Honorable Secretary of Agriculture.

Largest User of Dust Filters

MANY strange facts are discovered as byproducts of any search after knowledge. But none more curious has been discovered in our investigation of all aspects of atmospheric control than the fact that the industry that is most interested in securing clean, dust-free air, is not the food industry, not the hospital industry, not even the pharmaceutical industry.

It is none other than the steel industry that is apparently the largest user of air filters where they are used for the protection of motors and electrical equipment. Steel leads even department stores, hotels, and hospitals. Food lags way behind.

No Easy Way to Figure Costs

WHAT will an air-conditioning unit cost installed? We asked a number of equipment makers if there was any simple rule-of-thumb method of guessing what an installation would cost in round numbers.

They all said there was no simple way to figure it out any more than there was to figure out what a new electric motor, boiler or elevator would cost installed. It all depends on what needs to be done, how much, where, at what rate and how big.

WHY "Controlled Atmospheres" ARE IMPORTANT TO YOU

★

OUTSTANDING among all characteristics of human progress in technical fields since 1900 is an increasing independence of natural conditions and a growing domination over the vagaries of nature when it is worth our while to exert the effort.

To be sure, when we set out to control our atmospheric environment, we do not try to control all outdoors. But we are able to wall in any amount of space we need and produce accurately controlled conditions in that space; and, better yet, we can do it with greater satisfaction and lowered cost as the years go on.

To call this form of control of the atmosphere by the popular term "air conditioning" is correct only when certain definite conditions have been fulfilled. Much harm has been done to those who labor in the field of true air conditioning by the current indiscriminate use of the term, for the lay public has been gradually misled into a belief that putting an extra-efficient humidifying device onto a hot-air furnace for one's home is actually air conditioning.

Such an erroneous belief, though innocent in itself, works a hardship to those who are engaged in supplying the equipment and the knowledge of how to perform a real job of air conditioning, for it sets up false standards of values in the minds of possible users.

Real air conditioning involves many controls of the atmosphere all operating simultaneously: it involves both cooling or heating to a predetermined temperature; it involves controlling the humidity irrespective of out-door humidities. It further involves removal of dust from the air; the removal of obnoxious odors; and furthermore it involves control of the rate and distribution of air movement. And all of this costs a lot more money than the mere cost of a unit heater and a humidifier, or a unit cooler, or an air circulating fan for the reason that it is an engineered job, "tailor made" to fit a definite set of conditions in a definite place and is fully automatic.

The foregoing concept of true air conditioning is that of the American Society of Heating and Ventilating Engineers (ASH &VE). Anything involving any lesser degree of control of atmospheric factors is *not* air conditioning in the strict sense though it may be a form of controlling the atmosphere. Putting a unit cooler into a storage room is, therefore, not air conditioning: it is only a small part of it. Installing a humidifier is not air conditioning, nor is the use of an air filter or an air washer to be regarded as true air conditioning unless it is all hooked together in an integrated automatically controlled unit the performance of which meets the definition of air conditioning as adopted by the ASH & VE.

FOR these reasons the term Controlled Atmospheres has been selected to describe the subject matter in this special theme number of FOOD INDUSTRIES. This item also covers many other aspects of control of the atmosphere that ordinarily escape attention, for control of temperature, humidity, dust and air flow is only a part of the story—the physical part. There are also forms of control of the chemical composition of the atmosphere that are just as important as the physical control, though to one interested only in comfort air conditioning they may be meaningless. But in this issue of FOOD INDUSTRIES we are not interested in human comfort. Only the achievement of a desired technical objective under the highest obtainable degree of perfection involves our attention, and in a highly abbreviated form is presented the whole broad picture of the industrial possibilities of control of the atmosphere in terms of the reader's self-interest, together with descriptions of the equipment available for doing the different jobs.

A good reason exists for including discussions of control of chemical composition of the atmosphere with the discussions of physical control. In most cases they are inseparable in practice. For instance, control of

CO_2 in beef-storage in ocean transport is ineffective unless it accompanies temperature control. Neither can smoke control, in the process known as smoke curing of meats, be made effective without simultaneous temperature, humidity and air movement control, for without them it would not be smoking.

Likewise when ethylene is employed for accelerating the ripening of fruits and vegetables there exists the need for a controlled rate of air circulation. Furthermore, ozone is not ordinarily employed in food establishments unless it is used in a low temperature room accompanied by controlled humidity, temperature and air movement.

Hence to present a part of the field of controlled atmospheres without presenting it all would be to present a half-truth—to place an unwarranted emphasis on so-called "air-conditioning" factors alone—when future progress will undoubtedly supplement and augment the physical factors with chemical factors.

MANY industrial advantages are to be gained by the food manufacturer's complete control of the atmosphere of his plant or departments in his plant. These in general include the following:

(a) Retention or restoring of the original quality of the product or raw material.

(b) Prevention of spoilage, decomposition, molding, or their retardation.

(c) Prevention or retardation of drying.

(d) Maintaining of best possible conditions for carrying out a process or a manufacturing operation.

In all of the foregoing it should be remembered that comfort is *not* an objective—only profits.

In order to gain the most information from this "Controlled Atmospheres" Number it is advisable to keep in mind how the issue has been planned. First of all, a check sheet shows in detail how each of 55 different branches of food manufacture utilizes atmospheric control when the job is done well.

Though subsequent discussions reveal the distinction between chemical and physical control it is impossible to deal with them separately in a practical way.

THE scientific principles on which air conditioning rests are explained by a well-known air-conditioning engineer. The idea is to tell readers how air conditioning works, how the user employs it, how the engineer determines what is needed. His exposition is not for the purpose of making air-conditioning engineers out of every reader but to tell the reader what can be expected of air conditioning. Control of the rate of air movement is so important that another air-conditioning engineer has been invited to emphasize that phase.

Successful use of atmospheric control depends in part on the user. He has his own job to perform for he must learn how to use this new tool and adapt his own operations to standardized conditions. Kroger Grocery and Baking Co. realized that when they had the Kroger Food Foundation do the necessary research.

Next comes a description of important types of equipment used for physical control of atmospheres and a list of the principal manufacturers.

A brand new entrant into the industrial field is the new bactericidal ultraviolet lamp, the application of which is described in this issue of FOOD INDUSTRIES for the first time. It makes possible a form of control which we have named bacteriostatic control, by which is meant that where its rays are shining it is impossible for molds, yeasts and bacteria to grow.

Also there are competent lucid discussions of the biological principles underlying the handling of many foods. In some cases it is possible to "anæsthetize" them while in others the same treatment suffocates them. Anyone will be highly interested in this relatively new development. We ourselves have been fascinated by the discovery of the use of ethylene to aid in the husking of certain nuts.

Case studies of atmospheric control, taken from actual experience in food plants, although by no means exhausting the subjects, have been chosen to illustrate as far as possible the various combinations of the several factors shown in the check sheet, such as:

Type of Control	*Example taken from*
Bacteriostatic control	Meat Packing, Baking
Temperature control—mild	Essential Oils
Temperature control—medium	Fruits and Vegetables
Temperature control—low	Fish
Humidity control—low	Confectionery
Humidity control—medium	Milling
Humidity plus temperature control	Baking
High humidity plus air movement control	Macaroni
Dust control plus temperature control	Brewing and Egg Breaking
Full air conditioning	Brewing
Unsolved problems of humidity and temperature control	Meat Packing
Dust control plus humidity control	Meat Packing
CO_2 control plus temperature control	Meat Transportation
CO_2 control plus partial temperature control	Meat Transportation
Ethylene control plus temperature control	Fruits and Vegetables
Ozone control plus temperature control	Cold Storage
Smoke control plus temperature control plus humidity control	Meat Packing

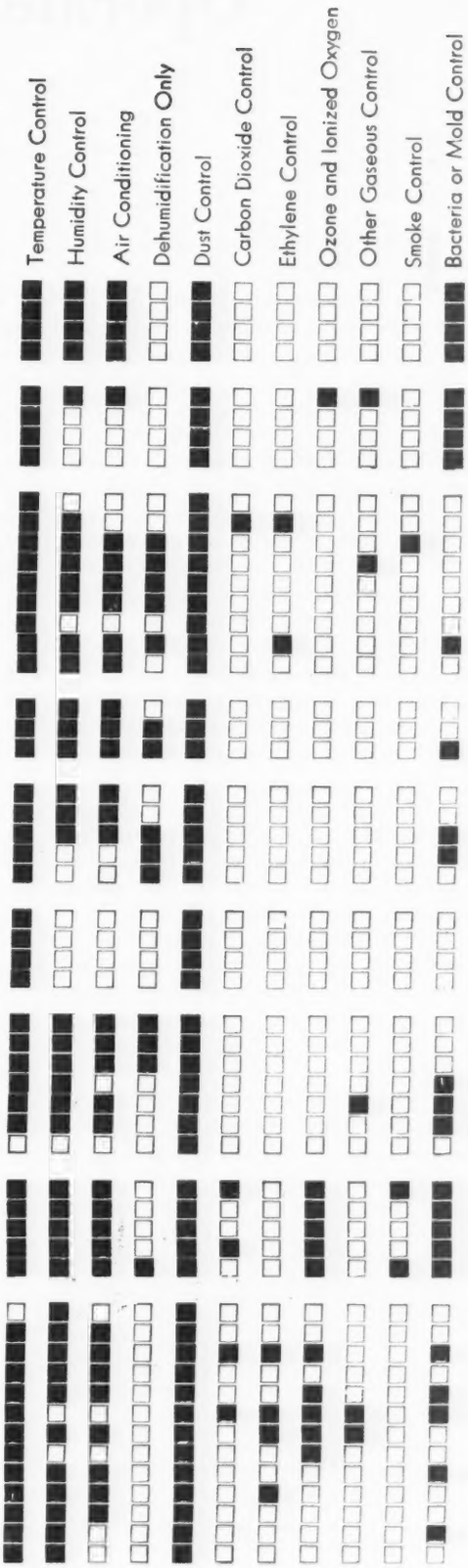
NOT all of the subjects can be covered within the confines of a single number of a magazine. Some of the articles will be left over to appear in July and August.

For the reader the important thing is to analyze his own industrial problems in terms of the type of control and determine in terms of dollars and cents what benefit such control would be to him. Remember your interest is in profits, not in comfort.

Controlled

Applications listed here are exclusive of those involving the control of atmosphere in cans, glass, containers or packages, being restricted to treatment of the atmosphere in rooms or other large enclosures.

Controlled Atmosphere Applications in the Food Industries



Bakery Products	Biscuits, Crackers
	Bread, Rolls
	Cakes
	Pies, Doughnuts, Specialities
Beverages	Beer, Wines
	Carbonated Beverages
	Fruit Juices
	Table Waters
Canned and Preserved Foods	Canned Fish and Shellfish
	Canned Fruits and Vegetables
	Dried Fish and Smoked Fish
	Dried Fruits
	Dried and Dehydrated Vegetables
	Glace Fruits
	Pickles, Horseradish, Mustard, Catsup, Kraut in bulk, Sauces
	Preserves, Jams, Jellies
	Salad Dressings, Mayonnaise
Confectionery and Chocolate	Chocolate, Cocoa Products
	Chewing Gum
	Confectionery
Dairy Products and Ice Cream	Butter
	Cheese
	Condensed, Evaporated, and Powdered Milk
	Fluid Milk
	Ice Cream
Fats and Oils	Lard
	Lard Substitutes
	Oleomargarine and Butter Substitutes
	Vegetable Oils
Flour and Grain Products	Cereal Preparations, Flaked
	Cereal Preparations, Milled
	Cereal Preparations, Puffed
	Corn Products, Starch, Syrup, Oil, Dextrose
	Flour and Other Grain Mill Products
	Malt
	Rice Cleaning and Polishing
Meats and Meat Products	Meat, Slaughtering and Packing
	Meat, Canned
	Meat, Packaged, Frozen
	Poultry and Poultry Products, including Eggs
	Sausages, Specialty Meat Products
Other Foods and Specialties	Baking Powder
	Coffee, Spice and Tea
	Cold Storage Warehousing
	Fish, Fresh, Filleted, Frozen
	Flavoring Extracts and Syrups
	Food Transportation
	Fresh Fruits and Vegetables, Packing
	Frozen Fruits and Vegetables
	Macaroni, Spaghetti and Noodles
	Processed Nuts
	Shellfish, not Canned
	Sugar
	Vinegar and Cider

How Industrial Air Conditioning Operates in the Food Field

By WALTER JONES
Carrier Engineering Corp., Newark, N. J.

THE principles of air conditioning have been well understood and applied for many years by those who are technically trained and well grounded in the subject. They have been applied to a great variety of industrial processes and there has been a wide diversity in the character and method of application. In some installations, the primary purpose is to produce a humid atmosphere with little, if any, temperature reduction. In many other cases a close control of temperature with a lowering of the relative humidity is required. Conditioning for human comfort, the application that today is most widely discussed, is an application requiring heating and humidification in winter, and cooling and dehumidification in summer.

It is, perhaps, inevitable that the focusing of the attention of the layman on the comfort field has also caused some confusion and misconception of the meaning of the term "Air Conditioning." Therefore, ni undertaking an objective discussion of the principles of air conditioning as applied to the food industries, it would be well to define air conditioning.

Fortunately, a clear and authoritative definition which is almost universally accepted is provided by the American Society of Heating and Ventilating Engineers, as follows: "Air Conditioning—The simultaneous control of all or at least the first three of those factors affecting both the physical and chemical conditions of the atmosphere within any structure. These factors include temperature, humidity, motion, distribution, dust, bacteria, odors, toxic gases, and ionization, most of which affect in greater or lesser degree, human health or comfort." This is a broad definition and can be simplified somewhat for the purpose of our discussion by combining motion and distribution under one heading "air motion" where it is understood to be air motion over the product. Next, by combining the factors of dust, bacteria, odors, toxic gases, and ionization, under the heading "air purity." We thus have three factors—temperature, humidity and air motion—which, it must be emphasized, must be under simultaneous control as a minimum provision for true air conditioning. The fourth factor "air purity" must be present in greater or lesser degree as required by the application.

IT is obvious then that the mere cooling or heating of air in a room which provides for temperature control and, incidentally, has an effect on the relative humidity (and also, because of gravity, an effect on air motion) does *not* constitute air conditioning because it does not coordinate and control all of these factors. A fan might be used in this room to provide controlled air motion, but again the room is not air conditioned unless adequate controls and equipment are provided to control also the temperature, humidity and, in some cases, purity.

For the air conditioning engineer to produce the required conditions in any application, it is necessary for him to know; first, the properties of air with respect to its temperature, humidity, motion and purity; second, he must know or have specified to him the conditions which are best for the product to be conditioned and, third, he must be able to select and design equipment which will provide these optimum conditions under adequate control regardless of outside atmospheric conditions.

THE air conditioning engineer cannot even start to do his job without adequate data on the properties of air. This has been provided for him in the form of the psychrometric chart, an abbreviated form of which is shown herewith. This chart is based on the rational psychrometric formulas discovered and published by Willis H. Carrier in 1911. It gives the values of moisture content, total heat, density and many other values at any given temperature or relative humidity. With the aid of this chart and complete information as to the characteristics of the product to be conditioned, the engineer can determine quantitatively the amount of air to be handled, the amount of heat to be added or taken away, the moisture which must be added (humidification), or subtracted (dehumidification), and he can determine the temperatures which must be maintained at the various parts of the cycle.

Knowledge of the properties of air and how to control them must be accompanied by a knowledge of those conditions which give the best results for the product.

IF the object of the conditioning operation is control of spoilage, those factors which cause spoilage must be known. It is equally important to evaluate the relative importance of each of the fundamental factors of air conditioning with respect to its control of spoilage. Microorganisms and bacteria are either present in large quantities in food products or they may be acquired by contact with the air. If the product is in a suitable atmospheric environment, these bacteria will multiply rapidly, causing spoilage and decay. Conversely, by surrounding the product with atmospheric conditions unfavorable to bacterial growth, freshness can be maintained and spoilage retarded. Bacterial growth is retarded by low temperatures. Spoilage can be reduced and retarded by keep-

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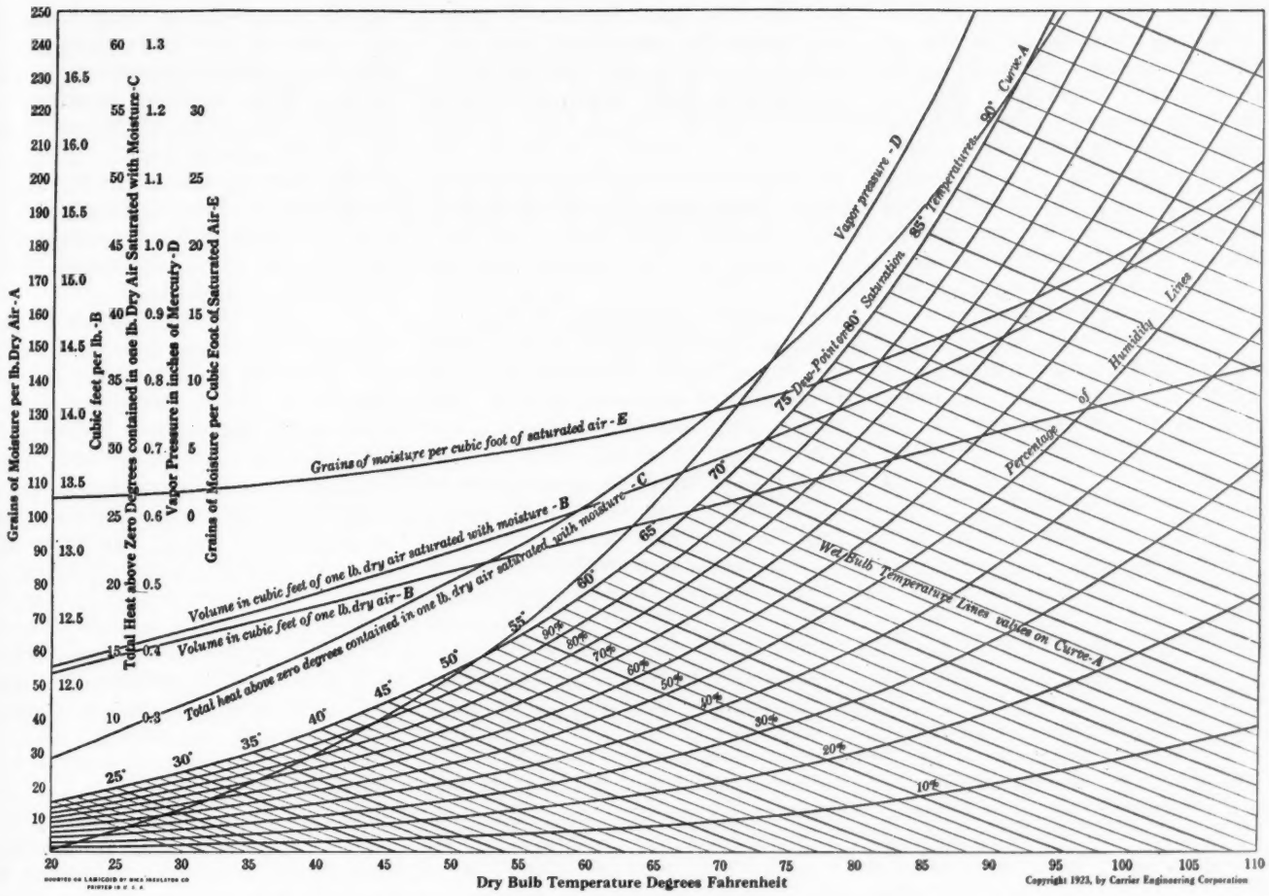

Grains of Moisture per lb. Dry Air - A
Cubic feet per lb. - B
Total Heat above Zero Degrees contained in one lb. Dry Air Saturated with Moisture - C
Vapor Pressure in inches of Mercury - D
Grains of Moisture per Cubic Foot of Saturated Air - E
Grains of moisture per cubic foot of saturated air - E
Volume in cubic feet of one lb. dry air saturated with moisture - B
Volume in cubic feet of one lb. dry air - B
Total heat above zero degrees contained in one lb. dry air saturated with moisture - C
Vapor pressure - D
75° Dew-Point=80° Saturation
85° Temperatures=90° Curve-A
Percentage of Humidity Lines
Wet Bulb Temperature Lines values on Curve-A
Dry Bulb Temperature Degrees Fahrenheit
Copyright 1923, by Carrier Engineering Corporation

A simplified form of psychrometric chart, which shows the inter-relations between the various properties of the atmosphere with which the air-conditioning engineer must work.

ing the product surrounded with pure air, which retards the transfer of bacteria and mold spores. In the case of meat products, the use of brine spray apparatus has proved effective because of the washing and germ removing action of the brine solution.

In the case of the prolonged storage of live products such as fruits and vegetables, ventilation is a necessary part of air purity. These products respire and give off CO_2 and other gases which must not be permitted to concentrate in a storage room. Dr. W. E. Ewell, in reporting experiments carried on at the Karlsruhe Laboratories in Germany, has shown that humidity has a marked effect on mold growth. It is much more rapid at high humidities even at low temperatures. Mold growth can be retarded by uniform and positively controlled air motion which eliminates stagnant areas where high humidities are built up when the product gives off moisture. Control of air motion combined with humidity control is also a factor in preventing insanitary conditions which result from condensation on floors and ceilings. The resulting drip provides breeding places for harmful bacteria.

MOST exposed food products contain moisture to some degree. In conditioning these products, it is seldom possible to consider humidity and air motion separately. The effect on animal products furnishes a good example of this fact. Drying or shrinkage of meat products is to be avoided except in those cases where it is the object of a process, such as curing of summer sausage. It is not possible, however, to completely eliminate shrinkage because there is always a certain amount of moisture working its way through the cellular tissue and coming to the surface. Such products must be surrounded with air at low temperature, slow and controlled air motion, and humidity that is high but still low enough to carry away the normal amount of moisture that comes to the surface. Mold growth and sliminess will occur in those areas where the air motion is too slow to prevent a film of high humidity air surrounding the product. In the areas where air motion is too rapid, the turbulence around the product will cause drying at too fast a rate and it will lose its fresh appearance by discoloration.

THERE are other classes of food products where drying or shrinkage is desirable and which are processed to obtain this result. Well-known examples which might be cited are: chewing gum, smoked meats, summer sausage. Since many of these drying processes are also effecting a cure in which biological changes occur in the product, the operating temperature varies within wide limits for different products. Summer sausage, for instance, is dried and cured at sub-normal temperatures, while temperatures for smoked meats such as ham and bacon are much higher. Regardless of whether the temperature is high or low, the product is usually surrounded with air at relatively rapid motion and relatively low humidity, since both of these factors tend to increase the drying rate.

Atmospheres

In the process of drying, the product gives up its moisture to the air and the air must in turn be dehumidified. At high temperature, this can be done by releasing from the room continuously a percentage of the high-temperature air with its high moisture content, and replacing it with a corresponding amount of outside air which has a lower moisture content; the outside air, of course, being preheated to the room temperature.

Reference to the psychrometric chart will show quantitatively how the foregoing is accomplished. Assume a smoked meat room maintained at 110 deg. F. and 50 per cent relative humidity (50 per cent saturation) and assume outside atmospheric conditions as of a rainy day with air saturated with moisture (100 per cent relative humidity) and at a temperature of 78 deg. F. In the outside air there are 10.2 grains of moisture per cu.ft. of air. The inside condition shows 13.0 grains per cu.ft. Obviously, the difference is accounted for by moisture taken up from the drying meat, and is explained by the fact that when the outside air temperature is raised to room temperature its relative humidity is reduced, as is indicated by the chart, to a value below the room value and it can absorb more moisture. If 1,000 cu.ft. per minute of outside air is added to the room and the same amount released, it will remove moisture from the room at the rate of 2,800 grains per minute, or 24 lb. per hour.

A crude illustration would be to consider each cubic foot of air entering the room as a container partially filled with water, to which water is added in the room and then taken out.

If drying is carried on at lower temperature, say, 55 deg. F. and 70 per cent relative humidity for a summer sausage room, the introduction of outside air at 78 deg. F. and saturated with moisture would only serve to add moisture to the room, since the room air would contain only 3.4 grains of moisture per cu.ft., whereas the outside air contains 10.2 grains per cu.ft. In this case, the room air must be dehumidified by mechanical cooling, preferably by passing the air through a cold water spray since the spray helps to purify the air and reduce odors.

The dehumidification and cooling of the air serves to lower the temperature and eliminate the moisture, both of which are desirable results. It is also desirable that the rate of dehumidification be substantially constant. Since the cooling and dehumidification are done in the same operation, it follows that the cooling rate will also be constant. Cooling, however, for the purpose of maintaining a constant room temperature is required only when outside temperatures are high and there is heat leakage into the room. When outside temperatures are low, the maintenance of the cooling rate for the purpose of dehumidification will result in cooling the room to undesirably low temperatures. This means that heating in the amount needed must be added to the cycle of operation to supply the deficiency. In the winter season, mechanical cooling may be dispensed with because the outside air will provide the cooling effect required for dehumidification and heating will maintain the room temperature.

Lemon storage and cooling is an example of product conditioning where the exact opposite of the foregoing is required with respect to moisture content of the air. The temperature requirement is about the same as given for summer sausage, but the humidity requirement is high—90 to 92 per cent. Cooling is required in summer to maintain the temperature requirement, but as dehumidification also unavoidably occurs with the cooling, the resultant humidity would be too low and undesirable shrinkage occur in the product. A controlled amount of moisture is therefore added to the room continuously by means of atomizing spray nozzles, to supply the deficiency.

THIS brings us to a consideration of the very important ratio of latent heat to sensible heat ratio. When air is cooled and dehumidified, heat is taken from it in two forms—sensible heat and latent heat. The measure of the sensible heat is the number of degrees of cooling, while the measure of the latent heat is the amount of moisture condensed. Similarly, when heat is added to air, it may be in the form of sensible heat (temperature increase) or latent heat by the addition of moisture (humidification). It is possible, however, to add moisture to air without changing its total heat content. When this happens, there is a conversion of sensible heat into latent heat, which is always accompanied by a corresponding decrease in temperature and, of course, an increase in relative humidity. This is the conversion which takes place in the evaporative cooling of air. The relation between the latent heat or moisture content of the air and its sensible heat is called the sensible heat ratio, and it is this factor which must be known, with some degree of accuracy, in connection with each product to be conditioned if the product is at all critical.

To explain the significance of this relationship, we can take a beef storage room as an example. In the process of cooling this room, the air surrounding the product is dehumidified. The product, on the other hand, because of its moist surfaces, acts as a humidifier and is constantly giving up moisture to the air. In doing this, it is converting the sensible heat of the air into latent heat, but it is not adding to the total heat of the air. When the weather is hot and there is a large amount of sensible heat leaking into the room, there is a relatively large amount of cooling with its accompanying dehumidification and, consequently, a large amount of sensible heat which the moisture evaporation from the product is converting into latent heat and the product becomes too dry. The remedy is to use spray humidifiers in the room to take this burden of sensible heat conversion away from the product. In other words, it is cheaper to evaporate city water than water that may have cost about 12 cents per pound from the meat. It is to be noted that the use of the spray humidifier does not add appreciably to the cooling load.

In this same beef storage room, under winter conditions, there may be a total absence of sensible heat leakage into the room. The product, however, goes right on converting sensible heat into latent heat until there is no sensible heat left to feed on. In other words, the air becomes saturated or nearly so, at which point the conversion ceases. This condition, however, is unfavorable, as it promotes mold growth and the meat surfaces become slimy. The remedy for this condition is to supply sensible heat to the room in the amount required to carry away the minimum amount of moisture but still leaving the meat surfaces in good condition without slime or mold growth. As has been shown previously, controlled air motion over the product is an indispensable aid and the use of a brine

(Turn to page 300)

Controlled

Rate of Air Movement of Vital Importance

By VERNON CANO
Cooling & Air Conditioning Corporation, New York, N. Y.

A PREDOMINATING factor in the design of many industrial air conditioning installations is the importance of the correct rate of air movement. Often it is far more important than close control of either temperature or humidity.

The job to be done, i.e., the purpose to be attained by the use of conditioned air, determines what rate of air flow should be utilized. The rate of air flow refers, not to its velocity in the ducts, but to its rate of movement in the space being conditioned. And this is determined by the type of outlets employed of which there are three general types: high velocity, medium and low velocity outlets.

High velocity is obtained by nozzle type outlets; medium velocity by directional type outlets equipped with movable or stationary vanes; and very low velocity is usually obtained by an outlet in the nature of a plain lattice type grille equipped with a damper.

A few examples serve to illustrate the type of service where the rate of air movement determines success or failure.

In bakeries, several departments require air conditioning. When air conditioning the bread-cooling department a very rapid movement is essential for the proper cooling of bread which leaves the oven at roughly 200 deg. F. Before it can be sliced or wrapped it is important that every part of each loaf be cooled to 85 to 90 deg. F. If the air movement in the cooling room is slow the bread will not cool within the required time. And, furthermore, if it is wrapped before it has been properly cooled it becomes moldy much more rapidly than bread which is in the right condition. On the other hand, if the velocity of the air is too high it will cause hardening of the crust and "checking" of the bread.

In the fermentation room just the reverse conditions are desired. A slow—very slow—air movement is used. If great care is not exercised in the selection of proper outlets a very unsatisfactory dough will result because of the large amount of evaporation of moisture and consequent crust formation on the dough if a rapid air movement is utilized.

▶ Control of air movement is particularly important for:

Bakery Products
Chocolate Products
Confectionery Products
Dried and Smoked Fish
Dried Fruits and Vegetables
Macaroni Products
Meat and Meat Products
Raw Material Handling

Insulation Important

ALMOST important feature of the dough room is the insulation of floor, walls and ceilings. Where proper insulation is absent the heat gain into the conditioned area will be so great that it can be compensated only by forcing greater and greater amounts of conditioned air into the room. And this will result in a higher rate of air movement. It must never be forgotten that a high velocity movement of air at higher per cent relative humidity can cause just as much drying as air at a lower relative humidity moving considerably more slowly.

In the manufacture of chocolate coatings the correct rate of air movement is a prime factor in the cooling and solidifying of the large cakes of coatings. After the chocolate coating has been refined it is brought to a temperature of about 90 deg. F., and then deposited into large pans. Next these pans pass through a conditioning tunnel in which the coating solidifies on all surfaces, but the inside still may be liquid. Only by the correct rate of air movement at this stage is it possible to make the entire bar set properly. Otherwise the bar will not have a proper fracture when broken, for the aim of the coating manufacturer is to obtain a fine, clean fracture. The latter is of the utmost importance if the bar is to be broken into small pieces for sale in retail stores.

Another excellent example of the importance of air movement is found in the manufacture of sausage and other meat products. In a frankfurter department, in addition to maintaining uniform temperature and humidity the air motion needs to be very slow. Otherwise the outside surface of the finished goods will be wrinkled and unmerchantable.

The foregoing examples illustrate the impossibility of setting down fixed rules governing the rate of air movement. The problem is further complicated by geographical differences, for what is right for a given product in Denver usually differs decidedly from correct practice for the same product in, say, New Orleans.

Wide experience and competent air conditioning engineering knowledge are very important for the correct solutions of these problems. But the user of air conditioning equipment must also understand the reasons affecting solution of the problems and be guided accordingly.

Atmospheres

Food Manufacturers' Responsibility Before Operating Under Air Conditioning

Any food manufacturer contemplating the use of conditioned air in his plant will be benefited by a study of the manner in which the Kroger Grocery and Baking Company investigated the problem of what must be done to get the most good out of the investment in new equipment. Important to note is that Kroger did not wait until the new air conditioning unit was installed to learn these things. They did not wait to experiment on a full plant-size scale. Necessary operating data was developed by research in advance of completing the entire installation.

By W. C. CULVER and GEORGE GARNATZ
The Kroger Food Foundation, Cincinnati, Ohio

AT FIRST GLANCE the term, "Air Conditioned Cookies," may appear to be an advertising man's phrase, but during the summer of 1935 it became reality in the production of our summer line of iced goods.

We had previously experienced no little trouble with the production control of iced pieces during the humid periods of our mid-west summers. Production executives had decided upon an air-conditioned room to solve the difficulties. In order that operating losses and delays could be eliminated it seemed wise to get the uncertainties out of the way before the plant installation was completed. We found there was real need for definite data on the constitution of icings and the relative "by-laws" of temperature and humidity.

A miniature icing operation was set up in the air-conditioned room of the Food Foundation laboratories, and we set out to study the best and most flexible combinations of humidity, temperature, formulas, and methods for producing trolley cookies of bright, smooth, stable appearance.

During seasons of cool or cold weather, iced cakes consist chiefly of marshmallow deposited on a plain base cake, and a protective coating of chocolate. When the weather becomes warm, a chocolate coating becomes impractical because its consistency will not hold up and it develops a grayish cast referred to as a "bloom."

Water-iced pieces are particularly in demand therefore during the summer, and dainty pieces of this type may be made on the trolley.

This device consists of two endless chains which travel back and forth at different levels. They are about 40 in. apart and at intervals of about 3 ft. are joined together by "spreaders" which hold the chains apart and keep them in alignment. On each chain, at intervals of 6 in., are small projections upon which bars, with a hook at each end, are suspended between the two chains. Each bar carries a series of pins upon which the base cakes are placed.

The action of the trolley is to convey these bars back and forth slowly, in a horizontal plane advancing successively to a higher and higher level. By this means the ceiling height of the room in which the trolley is located, is utilized from about the 3-ft. level on up. The speed of the trolley can be varied. This is governed by the rate at which the cakes dry, but the average speed is approximately 5 ft. per minute, requiring about 3½ hours for one complete cycle.

Girls hang the cakes on the pins while the trolley is in motion and at a short distance from the loading station the first dip tank is encountered.

At the dipping-tank a girl removes a unit of pins from the trolley, submerges the cakes in a tank of marshmallow icing and then replaces the unit to its original position on the trolley. The excess icing drains onto an apron just under the advancing pins, and scrapers return the icing to the dip tank.

After traveling for a suitable interval of time, the pins arrive at another dipping tank, where the process is repeated either with another marshmallow coating or with a protective coating of water icing.

Depending upon the nature of the piece being produced or the trolley installation itself, two or three dips may be given. In any case, after the final dip a period of time elapses during which the travel of the trolley is continued and the cakes have an op-

Controlled

portunity to dry. They are then removed by operators and packed. The pins go through a washing tank, emerging clean and ready for another charge of base cakes.

Whether a trolley piece receives two or three dips, the final one is a protective coating made chiefly of 6x sugar and water, variously colored and flavored. Through the evaporation of moisture from this icing, the sugar crystallizes. If the drying be accomplished rapidly, the crystals are minute in size and contribute to a high, glossy finish.

TYPES of cakes which call for a deposit of marshmallow on a base cake prior to treatment on the trolley require some attention to fit them to this procedure. It is necessary to deposit the marshmallow some time in advance to permit formation of a "skin" so that the piece may be hung on the trolley. The rate at which this "skin" is formed is vital. If too much time is required, the base cake absorbs some moisture from the marshmallow, with the result that it becomes too soft and fragile, consequently breaking and falling off the pins. When this condition is encountered, losses as high as 66⅔ per cent of the production are experienced. The only recourse in the event of a soft base cake is to postpone production until the base has dried out again. This is undesirable, since it adversely affects the marshmallow deposit.

The finish of trolley cookies can be of the high glossy variety, grainy, or spotted. Only the first is desirable. Experience has indicated that the formulation of the marshmallow coating and the water icing have a bearing on the results. In addition, however, and presumably beyond any compensations that can be made in the composition of marshmallow or water icing, atmospheric conditions have a profound influence. This is particularly noticeable in the absence of air conditioning and is also important when it is appreciated that the trolley is an unwieldy apparatus not well adapted to compensations for offsetting changed or variable conditions.

Since the chocolate variety is the type that reflects undesirable results to the most noticeable degree, it was used in the experimental work.

More than 200 combinations were investigated during the course of the work. In many instances individual tests were duplicated and in the more successful combinations additional replication was resorted to, in order to verify results.

The first series of experiments was devoted to bringing out the results obtained at varying relative humidities, maintaining room temperatures between 80-85 deg. F., and keeping the composition of the marshmallow and water icing constant. The marshmallow formula used was a revision of a typical commercial formula adapted to a procedure making use of a beater that was not equipped with a steam jacket.

The formula and mixing directions used are as follows:

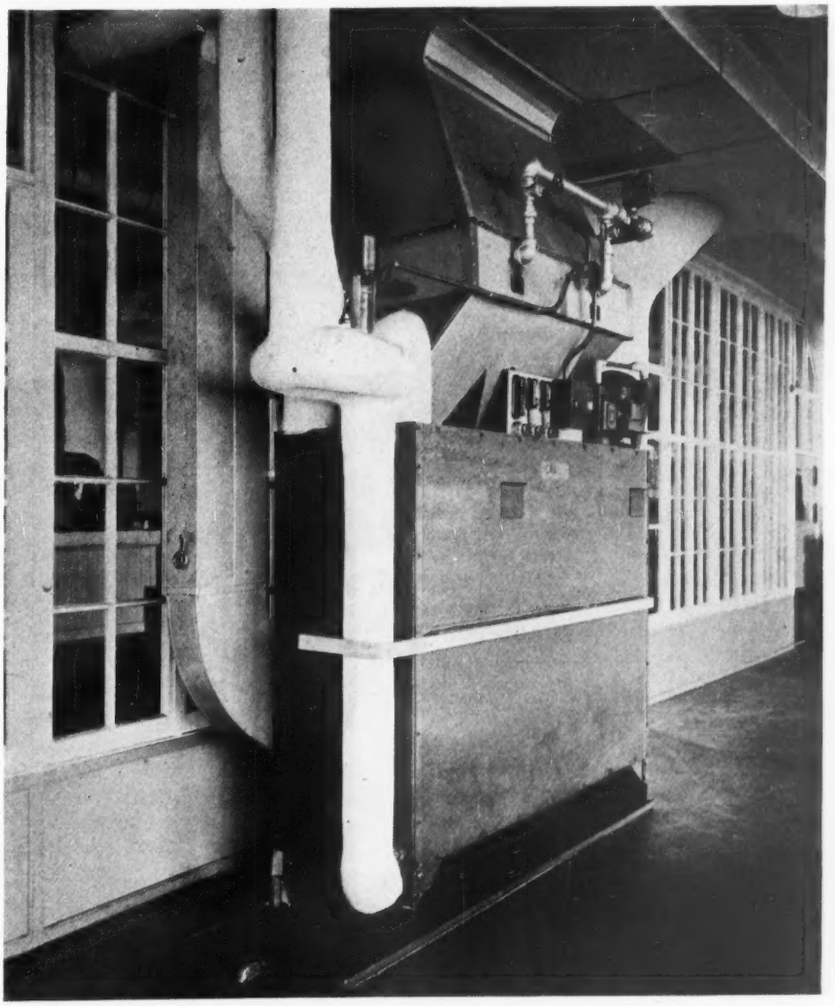
Sugar	44.3 per cent
Glucose (Dry Basis)	14.3 per cent
Water (total)	21.7 per cent
Gelatine	1.8 per cent
Chocolate Liquor	9.6 per cent
Cocoa Powder	8.3 per cent

The granulated sugar and water (except a portion of the water used for soaking the gelatine) were heated slowly until just below boiling, then the glucose was added and stirred in. The previously soaked gelatine was then added. The syrup was then reheated to 170 deg. F. and the mass was beaten in a Hobart mixer on the medium speed for three minutes. Cocoa powder and melted chocolate liquor were finally added and beating was continued for another minute. The marshmallow was held at a temperature of 114 deg. F. for dipping.

Thirty minutes after the marshmallow dip a second dip in water icing was applied. The formula used and the method followed in the making of this icing are given herewith:

Powdered Sugar (6 x)	72.3 per cent
Water	19.3 per cent
Glucose	4.8 per cent
Chocolate Liquor	1.2 per cent
Chocolate Color	2.4 per cent

To the heated water were added the glucose and melted chocolate liquor. This was then incorporated and the powdered sugar was added and mixed thoroughly. The chocolate color was finally added and the icing was stirred



This York unit does the air conditioning job for the trolley cookie department.

Atmospheres

just enough to uniformly incorporate the color. The icing was finished at a temperature of 90 deg. F.

After noting the results obtained at various relative humidities, the formulas for marshmallow and water icing were altered as indicated below, and used in connection with the humidities that gave fair results with the formulas as used originally.

For example, the water content of the marshmallow was increased and decreased. Small quantities of invert sugar were substituted for some of the granulated sugar and the proportion of invert sugar was gradually built up. The time between dips was varied; old marshmallow and icing were used; the sugars were not entirely dissolved. Likewise, the water icing formula was revised by using an increased proportion of powdered sugar; additional water; mixing all ingredients together; and using cold water instead of hot water.

THE results of these numerous experiments were graded and charted. The salient points gleaned from a study of the data and notes obtained led to the conclusions that are subsequently discussed.

At a relative humidity of 80 per cent, the cakes produced had a crystalline finish devoid of gloss. Temperature variation of the marshmallow in the dipping tank apparently did not affect the nature of the finish.

When the relative humidity was reduced to 70 per cent, the sugar crystals formed were somewhat smaller, but still too large since the cakes possessed a dull, unappetizing appearance.

Results at 60 per cent relative humidity, however, were very good. It is important to note though that the cake (especially the base cake on which marshmallow has been machine-deposited) softened down considerably. Twenty-five minutes between dips at this humidity gave best results. When the time between dips was lengthened beyond this, unsatisfactory results were obtained and the degree to which they offended was proportioned to the extent by which the time exceeded 25 minutes.

A humidity of 55 per cent yielded generally good results, but not quite so good as at 60 per cent. Still lower humidities resulted in cakes of somewhat spotted appearance, because the time between dips was too long. The dryer air absorbed too much moisture from the marshmallow, forming a "skin," so that when the water icing was applied some of its moisture soaked into the marshmallow resulting in the spotted appearance.

Trials in which the air velocity was accelerated indicated that within practical limits at least no deleterious effects need be expected.

The time between dips plays an important part in determining the nature of the finish obtained. It is essential that the first dip be somewhat dry, but not too dry before the water icing is applied. If the marshmallow be too moist when the water icing is applied, it will retard the drying and encourage the formation of large crystals and a dull finish.

What happens when the marshmallow dries out too much before the application of the water icing has already been described. All other factors being equal, the relative humidity of the air and the time between dips can be used to a certain extent to compensate for variations in one or the other.

Thinning of the marshmallow with simple syrup (one part water to two parts sugar) or with warm water, when the mix is too heavy produces a nice finish, but it is only temporary and spotting occurs after several hours.

Decreasing the water content of the marshmallow below a certain limit results in a poor finish, while increasing the moisture content within reasonable limits heightens the gloss and improves the finish generally.

Adding chocolate liquor and cocoa powder to the syrup before beating gives a darker, thinner marshmallow, but the volume is greatly reduced because the cocoa butter adversely affects the beating properties of the gelatine.

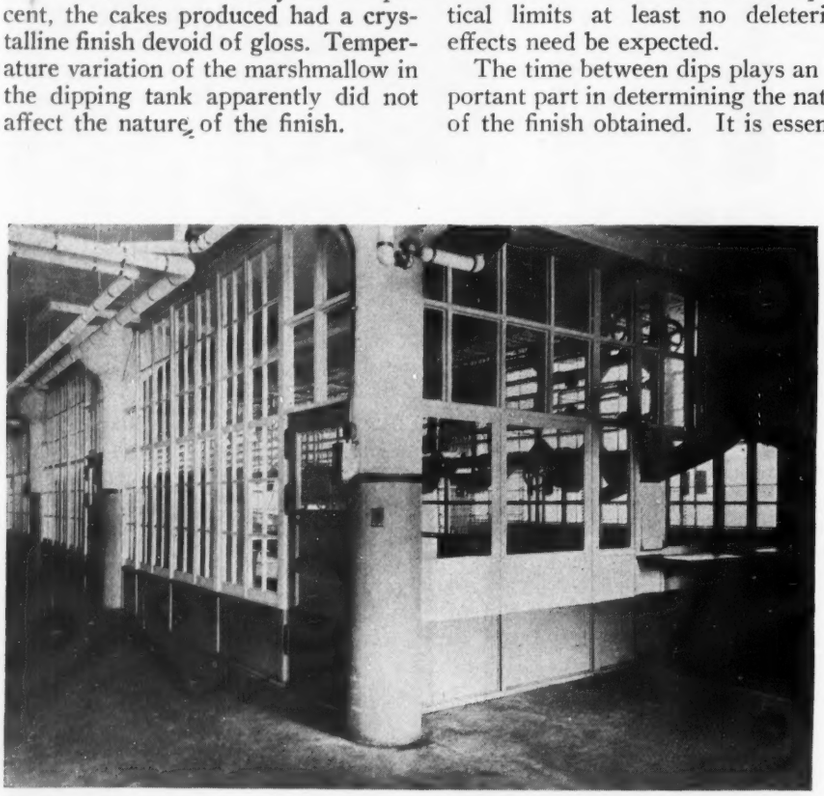
Old chocolate marshmallow, reheated to the proper consistency, produces a good looking piece of goods. This marshmallow, however, should not be thinned, since spotting is likely to occur.

Invert sugar replacing a proportionate amount of sugar and water in the marshmallow formula yields a better finish and contributes to greater flexibility of time between dips, as well as contributing to satisfactory results at relatively low humidities.

A heavier water icing apparently has no effect on finish, but a too thin icing slows up drying and causes a "pitted" effect.

The temperature of the water icing is an important factor in determining the quality of finish. A cold icing gives a dull finish, and when the icing is too warm, it becomes too thin and contributes to the "pitted" condition.

WITH the foregoing information developed by research, the production department was enabled to proceed with assurance and turn out goods of uniform good quality under controlled conditions at any time.



When it is profitable to employ conditioned air in a manufacturing operation the particular department should be housed-in like this. The trolleys and air ducts are visible.

Controlled

Equipment for Air Conditioning

A UNIT OPERATION OF FOOD ENGINEERING

Air Conditioning

► As with all things that take the popular fancy, air conditioning runs the danger of suffering from the great interest which it has aroused. One result of this interest has been the multiplication of types and makes of equipment for carrying out the various steps of air conditioning until today the layman has difficulty in keeping track of the utility and purpose of the many designs that are offered. The purpose of this article is to explain in simple language just how this equipment is employed—Editor.

This is No. 4 of a series on the unit operations of food engineering.

CONSIDERABLE mystery has grown up around the term "air conditioning," so much, in fact, that many food manufacturing plants hesitate even to investigate what has been presented to them as such a complicated problem. In contrast, others consider that the installation of so simple a device as a unit cooler, or unit heater, gives them an air-conditioning system. In consequence, any consideration of the equipment available for air conditioning must start with a definition of the operation.

In the fourth edition (1935) of their standard textbook "Heating and Air Conditioning" John R. Allen and James H. Walker give the following definition:

> Complete air conditioning involves the simultaneous control of the following factors:
>
> Temperature
> Humidity
> Air Motion
> Air Distribution
> Dust
> Bacteria
> Odors
> Toxic Gases
>
> Of these, the first three, temperature, humidity, and air motion, are paramount and no air-conditioning system deserves the name unless it satisfactorily controls these three factors.

It so happens that there are not many cases in the food industries in which control of all of the eight factors named by Messrs. Allen and Walker is necessary. These factors have been set up with the primary objective in mind of the air conditioning of buildings for human comfort. In food processing, what is sought is the attainment of the optimum manufacturing conditions with reference to the quality of the finished food product. To reach and hold these conditions generally requires attention to but five of the factors, namely: temperature, humidity, air motion, air distribution and dust. For the purposes of the food engineer, it is sufficient to consider a complete air-conditioning system as an installation of equipment which controls these five factors simultaneously, producing a predetermined set of atmospheric conditions in the space where the food manufacture is being carried out.

In addition to the cases where all five of these factors must be controlled, the food engineer will recognize that there are many cases in which the factors to be controlled are fewer, say temperature, air motion and air distribution. However, when such is the case, the same equipment can be used as is available for complete air conditioning, with the omission of unneeded units; or advantage can be taken of some of the devices available on the market which, as unit heaters or unit coolers, combine two or three of these factors.

With these general considerations referring to air conditioning in mind, the next step is to determine what must be successively done to air to condition it completely. While there are several alternate arrangements of these operations possible, for the purposes of this article it might be well to consider the following succession of operations:

1. Cleaning
2. Heating
3. Cooling
4. Moistening or Humidification
5. Drying or Dehumidification
6. Moving
7. Mixing
8. Distributing

It should be noted that, as air passes through these eight successive steps, each must be controlled. Adequate controls for this purpose are available, but, because of space limi-

Atmospheres

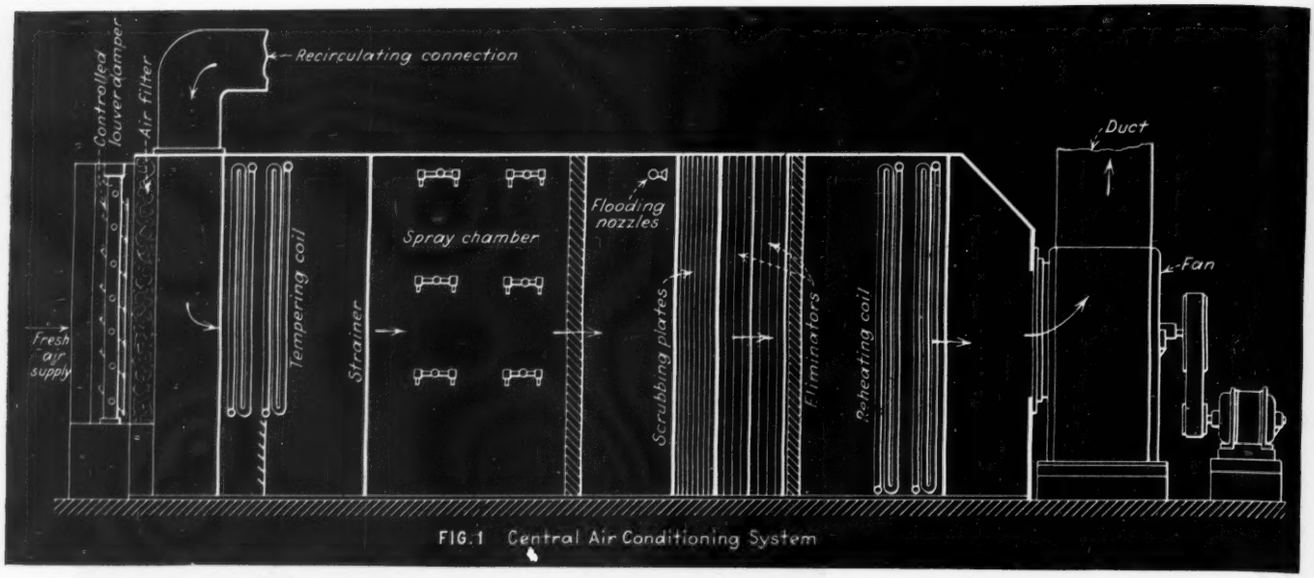


FIG. 1 Central Air Conditioning System

tations, detailed discussion of them is omitted from this article.

Also note that there are two general methods of installing air-conditioning systems: the central system and the unit system. In the central system, most of the equipment is in one place in the plant and the conditioned air is carried through distributing ducts to the point of application. In the unit system, some of the equipment, as, for instance, refrigeration equipment may be centrally located for the whole plant, but a number of sets of the actual air treating equipment are located at the various points of application.

In Fig. 1 is seen, in outline, the assemblage of units that go to make up a complete central air-conditioning system; while Fig. 2 shows one type of unit used in the unit system. It is apparent that these two installations embody essentially the same equipment, though of varying design.

Reference to Fig. 1 will identify the various parts of the system, and their functions. Fresh air enters as shown, the opening being generally protected by a screen and louvers, so that large items of foreign material may be kept out and also the size of the opening varied as required. Next in order comes an air filter or cleaning device for removing as much as possible of the dust in the air. Depending on the type of cleaning device employed, at least some of the micro-organisms in the air are also removed by this operation.

If the plant is in a region where the temperature falls below freezing,

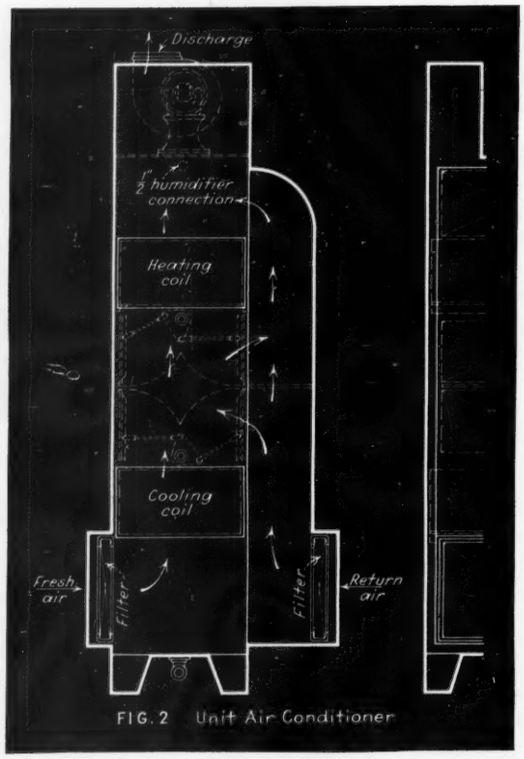


FIG. 2 Unit Air Conditioner

a heating device is so placed that the temperature of the incoming fresh air will be raised to about 45 deg. F. This prevents the freezing of moisture in the air washer or spray chamber when these are employed.

The air next passes through this air washer or spray chamber, which serves to give it the desired moisture content and cool it. On leaving this point it is clean air with a definite humidity, but is too cool for most purposes. Hence it next passes through a heating coil, to raise its temperature and at the same time "dry" it. Here it is important to recall the meaning of the term "relative humidity," and, for example, the fact that air which is saturated, i.e., contains all the moisture it will hold at 45 deg. F., or has 100 per cent relative humidity, contains the same amount of moisture at 70 deg. F., but has only 50 per cent relative humidity. This means that the 70 deg. air can take up as much moisture again as it already contains before it becomes saturated. Hence this heating operation, while it does not actually dry the air, is called a "drying" operation because it increases the ability of the air to take moisture from other substances by decreasing the relative humidity of the air. Drying of the air is also accomplished by the use of dehumidifying equipment of various types, such as those emloying chemicals like silicagel or activated alumina to absorb moisture from the air.

In many air-conditioning systems only part of the air supply is taken from the fresh air inlet, and the remainder is recirculated from the air-

Controlled

conditioned rooms or spaces, and is mixed with the fresh air. This recirculated air has taken up heat and moisture. The point of its introduction into the air-conditioning system, and the amount recirculated in comparison with the amount of fresh air used, will depend, among other things, upon the temperatures and humidities of the fresh and recirculated air. If it is necessary to remove dust or odors from this air, it will all be introduced between the first heating coil and the air washer. In other cases some, or all, of it will be introduced after the fresh air has passed through the air washer.

This mixing of recirculated air with fresh air is controlled by dampers in the two supplies, the relative area of the two openings governing the relative amounts admitted.

Movement of air is, with all types of air-conditioning equipment, accomplished by means of one of the many available designs of fans or blowers. This is used to impart sufficient head to the air to move it to the desired places, through ducts in the central air-conditioning system, through the outlets, and finally, to the desired place in the conditioned space.

Distributing the air is an operation involving the rate of air movement, the location of outlets for conditioned air and inlets for used air to the return system and to the vent to atmosphere, and the conditions in the conditioned space. It does not involve any additional equipment, except controlling devices, but is a matter of correct design and installation.

Before considering the individual items of equipment that go to make up a complete air-conditioning system, two points need attention. First, the unit systems duplicate, on a smaller scale, the apparatus used in the central systems, with the exception that extensive ducts for air distribution are not needed. Second, whether the system installed is the central or the unit system, its degree of completeness will vary with the service which it is to perform. In many installations, for example, only heating and dehumidification are required, as when the system is used to maintain warm, dry conditions surrounding a product that is being dried. Therefore, the system installed will be made up of a selection of the various items of equipment suited to maintaining only the conditions required over a predetermined range.

Several omissions are made from the following discussion of equipment. No detailed discussion of controlling instruments is given, for, while it is true that air-conditioning systems cannot operate without fully coordinated, automatic controlling systems, the subject is so detailed and technical as to be beyond the compass of this article. Also primary heating, cooling, and air-moving devices such as boilers and refrigerating units are not considered, as these are items of general industrial utility, not in themselves part of air-conditioning equipment. Finally, detailed consideration has been omitted of accessory equipment such as louvers, dampers, ducts and grilles, which are available in sufficient variety to meet the needs of any air-conditioning installation.

Cleaning, heating, cooling, humidifying, and dehumidifying equipment are the essential parts of the air-conditioning system discussed hereafter.

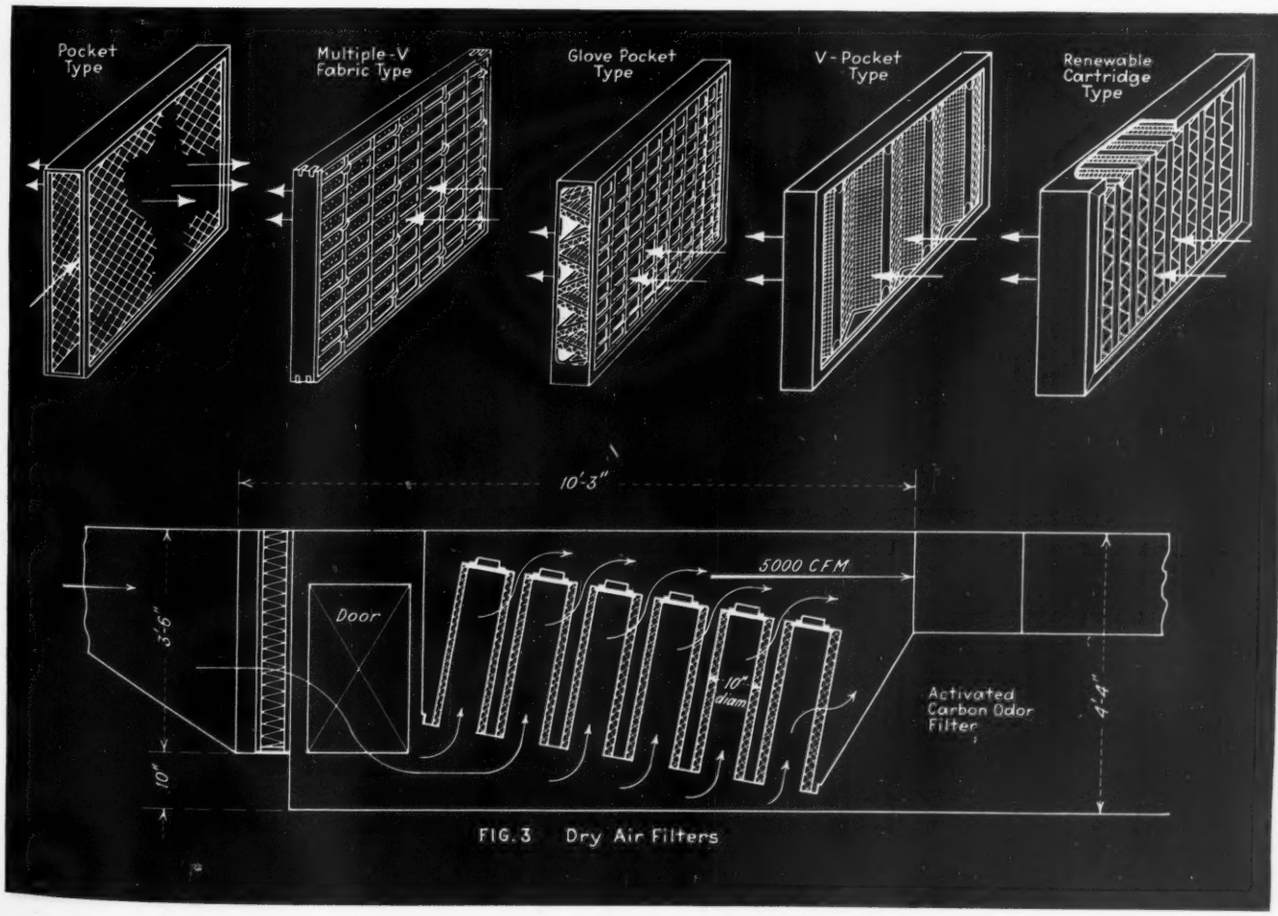


FIG. 3 Dry Air Filters

Atmospheres

Cleaning Equipment

AIR cleaning devices are of two general types: filters and washers.

Air filters may be either of dry or viscous type. Several designs of dry filters are shown in Fig. 3. These clean the air by forcing it to pass through many small openings while at the same time direction of flow is changed many times. These labyrinthine passages are obtained by interposing in the air stream a frame containing such materials as a number of layers of cellulose, cotton duck, felt, hair, glass wool or similar material. The dust is removed by causing it to lodge in the small passages. Dry filters for removing odors are also available, using activated carbon as the filtering element.

The viscous type of dust filter, shown in Fig. 4, makes use of a coating of heavy oil or other adhesive carried on crimped wire screens, expanded metal screens, glass wool, processed hair, or bias-cut corrugated cardboard. In these filters the air is caused to pass in thin streams between the coated surfaces, to which much of the dust adheres.

In both these filter types, the filter is cleaned by washing or by a vacuum cleaner, except in some of the newer types, where the filter element is of inexpensive construction, so that it can be discarded when dirty, and a new filter element substituted.

Automatic self-cleaning features some of the more expensive air filters suitable for high capacity installations, such as that shown in Fig. 5. In a viscous filter of this type a belt of the filtering materials, say wire mesh, is arranged vertically, held between two endless chains, passing over top and bottom sets of sprockets. At the bottom the belt dips into a reservoir of oil and the upward-moving part of the belt, thus coated with fresh, clean oil, is used for filtering. Dry filters of the self-cleaning type generally use fabric filtering material from which the dust is removed by shaking, beating, vibration, or an air blast.

Air washers, shown in Fig. 6, consist of chambers in which the air is caused to flow through finely-sprayed or atomized water. They perform the primary functions of cooling the air and changing its relative humidity. Incidentally, air washers also clean the air, removing dust and some odors. These devices are used with central systems for air conditioning and in some unit conditioners. It is customary to place an air filter in the fresh air inlet, and also in the inlet for recirculated air to the air washer, to cut down the amount of dust and dirt entering the washer. This prevents the spray nozzles from becoming clogged and, in cases where the wash water is recirculated through the sprays, this water does not become unusably dirty in so short a time.

Where air washers are depended upon for eliminating odors, the circulating water must be kept fresh, as the water, when reused, soon ceases to remove odors.

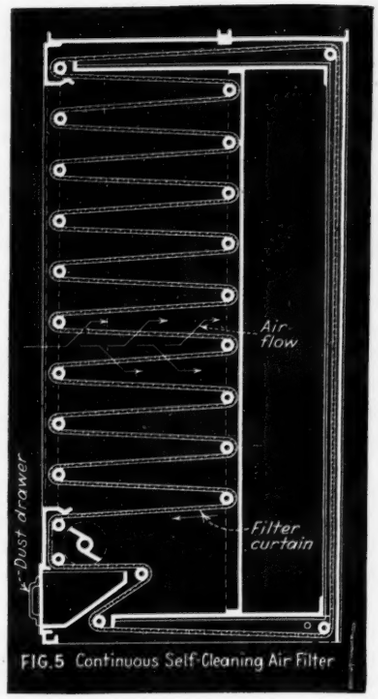


FIG. 5 Continuous Self-Cleaning Air Filter

Air filters are also placed in the bypass for recirculated air, when part of this air is passed around the air washer and enters the system just before the mixing dampers and fan. This serves to remove from the recirculated air any dust that may have been picked up in the conditioned space.

Air filters of the dry and viscous types usually have about 400 sq.in. of

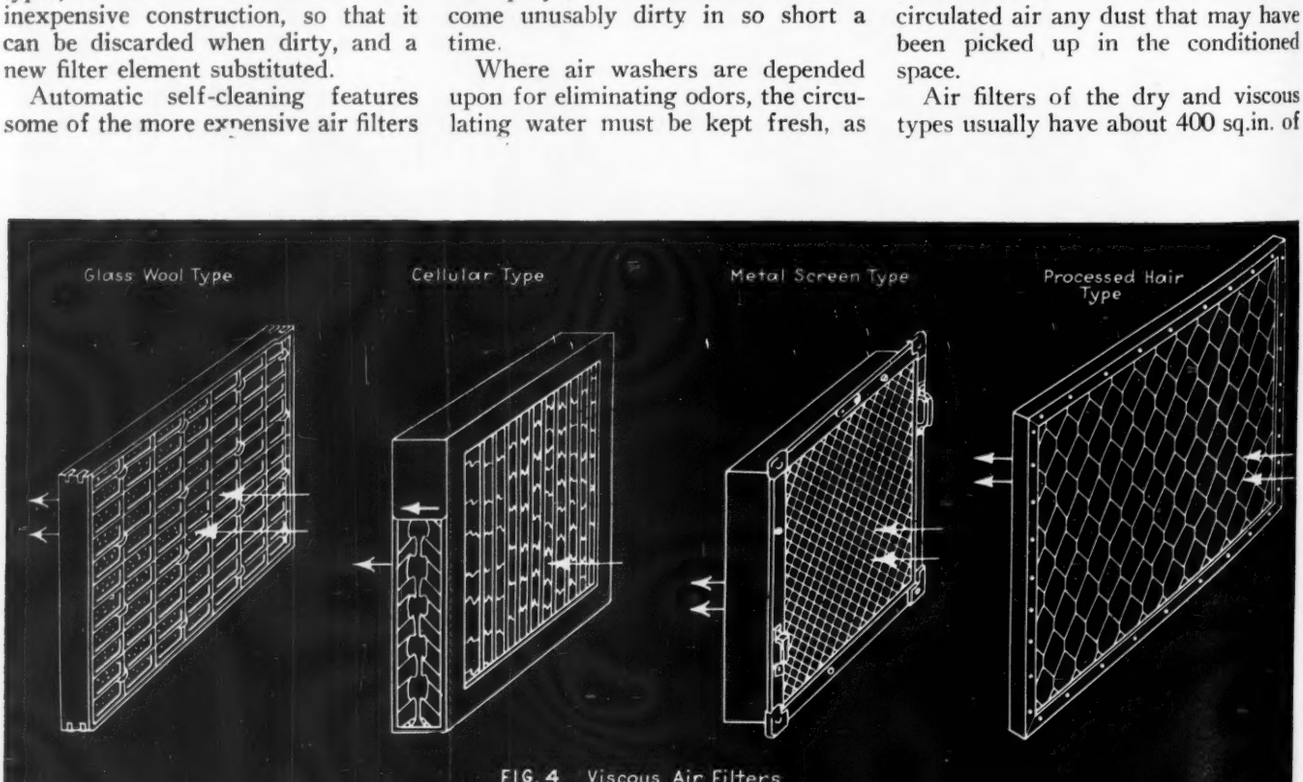


FIG. 4 Viscous Air Filters

Controlled

surface, offer a resistance to air flow equal to one-tenth to one-quarter of an inch of water, and will pass from 800 to 1,000 cu.ft. of air per minute at the usual air velocities of from 300 to 400 ft. per minute. When dirty, the resistance to air passage increases, and hence cleaning or replacement of filtering media becomes necessary. Where dust concentrations are heavy, the interval between cleanings or replacements is lessened. It is well to install a draft gage to show the difference in pressure between the air filter inlet and outlet, so that the necessity for cleaning becomes evident.

Two cautions concerning filters. Some types of filters are less efficient with certain industrial dusts than with others, and consequently filters should be installed that will be effective against the kind of dust encountered. Filters should be placed so that the air strikes them perpendicularly. This can be done by setting the filters at right angles to the air flow in the duct; or, where this cannot be done, by installing guide vanes to direct the air flow.

Heating Equipment

HEATING of air in air-conditioning systems is accomplished by some form of radiator, with steam as a heating medium. The usual radiator is made of finned tubes, which may be of one of several designs some of which are shown in Fig. 7. In general, these radiators consist of tubes carrying closely spaced fins or flanges of stamped metal, into which the tube has been inserted by pressing; or cast iron sections bearing knobs, fins or protuberances cast on the outer surface. In the first case the tube ends are rolled into top and bottom headers for supply and return; while with the cast iron heaters, the sections screw together after the manner of the familiar domestic steam radiator.

Heaters are supplied with a thermostatic control on the steam supply, and a trap at the outlet to handle the condensed steam. Air vents, similar to those used on space heating radiators, are also used.

Reference to Figs. 1 and 2 will show that the air flow through the system is restricted by the heaters, as these are, in general, of the same total area as the washer, or other air passage in which they are located, and the area of the tubes and fins cuts down the area available for air passage. This results in the air moving at greater velocity through the heater section than it does on either side, and consequently, the heating capacity of the heater must be selected with this higher velocity in view, rather than the velocity of air movement through the system as a whole.

The capacity of air heaters required for any given case is determined by the number of pounds of air being circulated and the rise in temperature required.

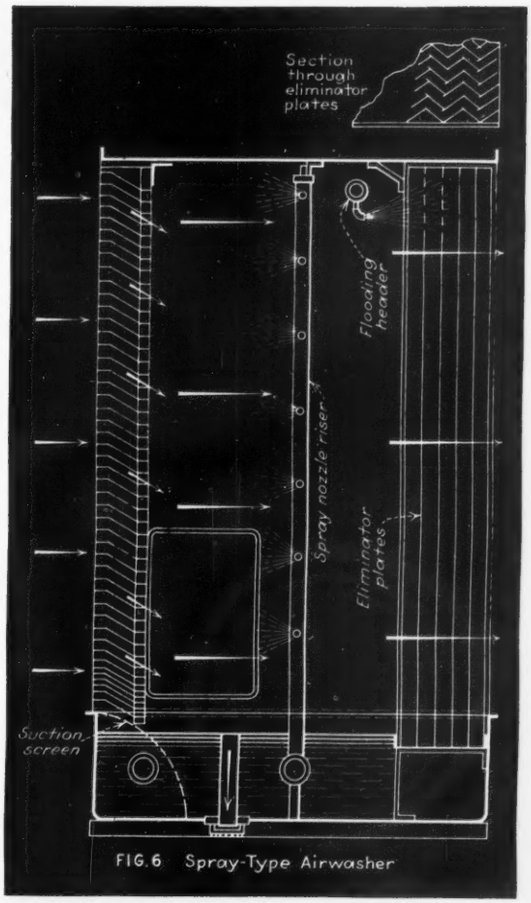


FIG. 6 Spray-Type Airwasher

Air heaters are installed at the fresh air inlet, where they are used in cold weather to raise the incoming air temperature well above the freezing point. For some purposes, it is best to do the entire heating at this point. In other cases, additional heat is obtained by using heated water for the spray in the air washer. Heaters are also used at the point where the air leaves the air washer. In this arrangement, the air entering the washer is heated to such a point that it will pick up the desired humidity in the washer, in cases of a cool, dry air supply; or will be "dried" to the desired humidity by being cooled, in cases of a warm, humid air supply. In either case, the relatively cool, saturated air leaving the washer is heated to the desired circulation temperature by the heater placed after the washer, which at the same time reduces the relative humidity, giving to the circulating air capacity to absorb more moisture when it reaches the conditioned space.

Another use for heaters is as boosters in the air ducts of central systems. Heaters are thus used, in long air ducts, when duct heat losses would cause the air to reach the space to be conditioned at too low a temperature.

It should be remembered that heaters, wherever located, must be automatically controlled and coordinated with the other elements of the air conditioning system. Only by such control can predetermined conditions be steadily maintained.

Cooling Equipment

FOR cooling air, two types of equipment are available: the cooling coil, and the water spray or air washer. Which of these is used will depend upon the type of air conditioning system employed, and the degree of cooling necessary. Both usually require the use of refrigerating systems.

Cooling coils are, in general, similar to fin-tube heaters in design. In fact, in some designs of unit conditioners (principally those used for comfort conditioning in stores and offices) the same coil is used for heating in winter and cooling in summer. These coils will vary somewhat in design, depending upon the cooling medium used. Cooling is accomplished by water, by brine, by flooded, or by direct expansion systems. (See articles by L. A. Ramsay, FOOD IN-

Atmospheres

DUSTRIES, October, 1935, p. 478, and November, 1935, p. 526 for a discussion of the brine, flooded and direct expansion systems). The cooling effect is obtained with coils by air passing over the coil and fin surfaces, which are cooler than the air, and to which the air consequently gives up heat. In doing this, the air is often cooled below the dewpoint, that is, cooled beyond the temperature that would cause it to have 100 per cent relative humidity. In such cases, moisture condenses out of the air on the surface of the coils and a suitable means of collecting this moisture and draining it off should be provided with all cooling coils.

The air washer, shown in Fig. 6, has already been discussed as a means of cleaning air. It also cools air at the same time, if it is supplied with cool water sprays, whereas, if the spray is of heated water, it may be used for heating air. The washer, instead of being supplied with sprays of cool water, is sometimes built with a cooling coil, cooled by some refrigerant. Water is sprayed, or allowed to trickle over these coils, and thus becomes cooled, so that air passing through it is in turn cooled. This is more economical than having the cooling water cooled in a separate cooler or cooling tower, but is sometimes prohibited by safety ordinances.

In some plants, well water cool enough for the coils is available.

Because water is picked up in the form of mist or fog, as well as vapor, by the air passing through the air washer, the outlet of the washer is provided with some form of eliminator to remove this water and prevent its being carried on through the system to be deposited in ducts or on equipment. These eliminators generally take the form of a bank of zig-zag plates, and, in passing through them, the water is literally knocked out of the air.

The choice between spray coolers and coil coolers depends up the design of the air-conditioning system, whether of central type or unit type; and upon the degree of cooling that is desired. For the supply of relatively warm air of low enough humidity to pick up moisture in the conditioned space, the water spray type of cooler is somewhat more economical, requiring less refrigeration. However, the air washer, well-suited to central air-conditioning systems, is not so useful in the unit conditioner, because of its bulk. Modified spray systems are used, however, in some unit conditioners. In applications where low temperatures are necessary, as in cold storage rooms, the coil cooler must be employed in order to get the temperature low enough, while for intermediate temperatures, a coil cooler or a brine spray can be employed.

With coolers, as with heaters, accurate automatic control, coordinated with the controls of the other parts of the system, must be employed in order to maintain the desired conditions.

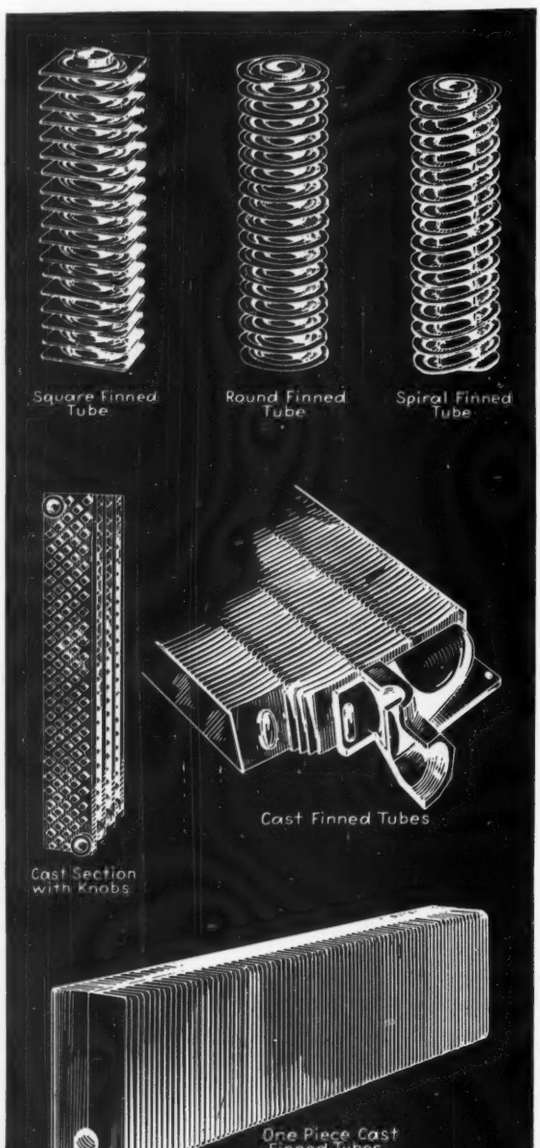


FIG. 7 Heating Coil Types

Humidification Equipment

HUMIDIFICATION, or moistening, of the air circulated by an air-conditioning system, is a necessity at all times for certain processes, and must be used in winter in most applications where fresh air is circulated, because of the low moisture content of cold, fresh air. In the latter case, the air washer shown in Fig. 6, will serve with central systems, while a spray is used with the unit conditioners.

Where sprays are not used one or more humidifying units, as shown in Fig. 8, can be used. The principle of operation of these unit humidifiers in most cases involves the use of a motor driven fan of the propeller type, which drives a current of air through a spray of water, delivered in the direction of air flow. Others employ a spray or trickle of water, directed against a rapidly revolving rotor. In any case, the operation of unit humidifiers should be controlled by a humidistat, to keep the moisture content of the air in the humidifier space within the desired range.

Two other methods are used for humidifying air delivered from unit conditioners, in cases where strict adherence to a predetermined humidity is unnecessary. One is the pan humidifier, consisting of a shallow pan of water over which the air is caused to flow. Water level in these pans is kept constant by a float valve, which permits water to flow in from the supply line, when evaporation reduces the level in the pan. The other type consists of wicks or pads of fabric, which are kept wet by a trickle of water. When air flows around these

Controlled

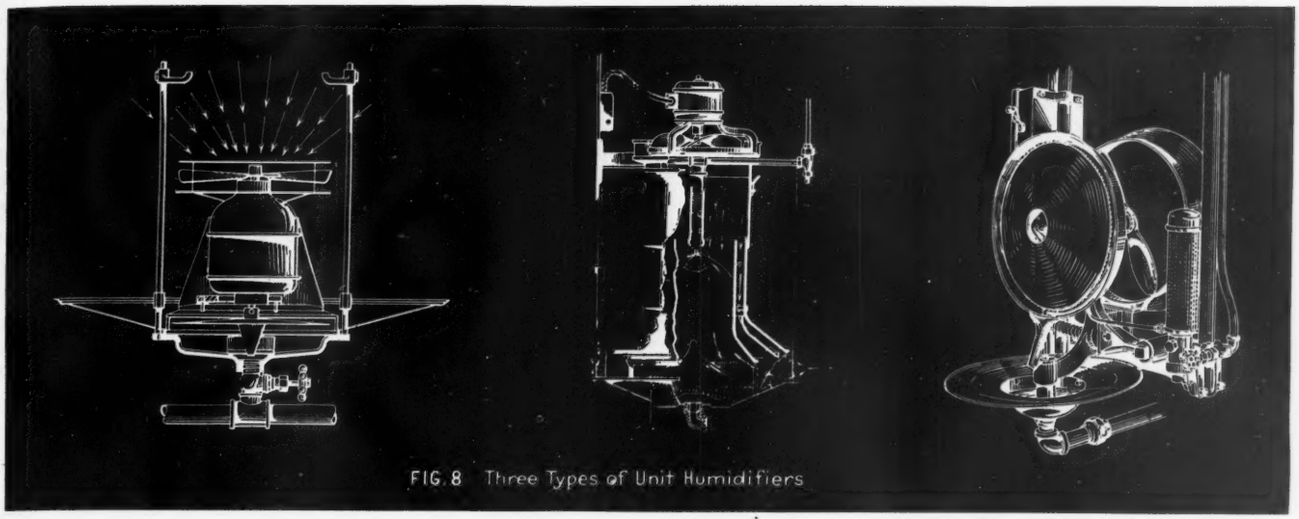


FIG. 8 Three Types of Unit Humidifiers

pads it takes up water, thus increasing its humidity.

In air-conditioning systems using the air washer for humidifying, the amount of moisture taken up by the air can be controlled by regulating the temperature of the water. In this case, if the air leaves the washer saturated at the temperature of the water, its moisture content is a definite figure. Another method of controlling the humidity of the air leaving a washer, is to preheat the air entering the washer to a definite point, and then recirculate the spray water without cooling. In this case, the spray water soon reaches a steady temperature somewhat below the temperature of the entering air, and the air in passing through acquires a definite relative humidity. This air preheating can be done with heating coils, or by admitting recirculation air in controlled amount before the entrance to the air washer.

Dehumidification Equipment

MANY industrial processes require an air supply with a definite relative humidity of some figure less than 100 per cent, particularly if the air is depended upon for removing moisture from the products or from the atmosphere of the conditioned space.

Two general methods for dehumidification are employed: 1. By cooling air below the dewpoint, that is, by cooling it sufficiently to cause moisture to condense out. This method employs the cooling coils, sprays, or air washers, already discussed. 2. By passing the air through dehumidifiers, in which it is brought into contact with some chemical having the property of removing water from air.

Among the chemicals used in dehumidifiers are silica gel, activated alumina, calcium chloride and lithium chloride. These chemicals are employed because with them the water is adsorbed, that is, adheres to the surface. For this purpose, the two chlorides are used in the liquid form as solutions. Fig. 9 shows a dehumidifier of the chemical type.

For processes where the moisture content of the conditioned air must be very low, use is made of the chemical type of dehumidifier, as the expense of dehumidifying to any great extent by cooling is often too high.

Air Moving Equipment

FANS and blowers of standard design are used for moving the air through an air-conditioning system and distributing it at the correct velocity and in the correct quantity at the point of application. With complete air conditioning, choice of a fan for this purpose can be easily made by means of the tables of fan characteristics published by makers of this equipment. Fan designs are well-established and any qualified engineer can readily select a fan suitable for his conditioning system, once the requirements are established.

In the complete air-conditioning system, fans are used for two purposes. A fan sucks fresh and recirculated air through the cleaning, heating, cooling and humidifying equipment and delivers it to the conditioned space. Another fan is used for removing used air from the conditioned space, to be discarded or recirculated, depending upon the design of the system. Other systems do not generally employ an exhaust fan.

In selecting fans, allowance must be made for the resistance to air-flow set up in the conditioning equipment and in the distributing ducts, dampers, grilles and louvers. In addition to this allowance, it is usual to allow some excess capacity in fans, as a factor of safety.

Exhaust fans are usually selected with such a capacity relation to supply fans as to maintain a pressure slightly above atmospheric pressure in the conditioned spaces. This prevents leakage of unconditioned, outside air into the conditioned spaces.

Mixing and Distributing

MIXING in a complete air-conditioning system may occur at three points. Two of these points involve the mixing of recirculated air with the fresh air supply. This may occur before the air enters the air washer, after it leaves the air washer, or at both places. The third point where mixing occurs in some systems is where final heating is accomplished by passing part of the conditioned air through heating coils after it leaves the distributing fan, while the remainder does not receive this additional heating, but is led around the heater and then mixed with the heated portion.

In any case, this mixing is controlled in such a way as to give the correct proportions to the two streams of air being mixed. The essential equipment is a damper of some kind, generally made up of a number of leaves, and constructed so that the opening can be varied from zero to full. A similar damper

is placed in the fresh air inlet. The opening of these dampers is automatically controlled and coordinated with the control of all other factors in the system.

Distribution of air is concerned with two problems. One, occurring chiefly in the central systems, but also with multiple-outlet unit conditioners, involves the distribution of the air through ducts to the points where it is delivered to the space that is being conditioned. The second involves the introduction of the air to the conditioned space at such points, and with such velocity, as will insure its proper distribution and effectiveness through this space.

The first of these problems is concerned with the correct proportioning of the ducts, in such a manner that the air flows in correct amounts, through the various ducts without undue losses caused by restrictions or bends in the ducts. This is a problem that can be solved correctly only by an engineer with experience in the field of air flow. A tinsmith can construct an impressive duct system, full of beautiful sweeping curves, but it is extremely unlikely that such a duct system would work well, however much it might save in first cost.

How air shall be introduced into the space that is being conditioned will depend upon the result that this air is supposed to accomplish, the size and shape of the space, the velocity of the entering air, the quantity of the air introduced, the quantity of air removed, and the location of the place or places of air removal.

It should be kept in mind that air entering a room, depending upon its velocity, will pick up and move along with it a greater or less amount of the air in the room. Also cold air falls and warm air rises. The method of introducing the air can best be determined by an experienced engineer, who has all the necessary information placed at his disposal. (See also p. 275 "Rate of Air Movement of Vital Importance," by Vernon Cano).

In any case, no equipment other than grilles, registers, louvers, or dampers is required in this phase of distribution.

Control Equipment

IN controlling an air-conditioning system, the object is to vary the supplies of steam, refrigeration and water, and the flow of air, so as to maintain the desired conditions steadily in the conditioned space. These controls must be coordinated, so that they work together. For best results, they should all be automatic.

The controls used in industrial installations should be of the recording type, so that a record may be available for the management showing what conditions prevailed at any time. The temperature controls and controlling flowmeters for air and liquids that are used for this purpose are all standard and will not be described here. The only instrument not generally used for other purposes is the humidistat. This is a device that is sensitive to changes in relative humidity. Its actuating element is hygroscopic, expanding as the relative humidity increases and contracting as the relative humidity decreases. This change is sufficient, when stepped up by a relay or pilot, to actuate a control. Humidistats are often combined with temperature controls of the thermostatic type in a single instrument designed to maintain constant temperature and relative humidity. Humidistats must be located where they are exposed to air movement or their action is sluggish and unsatisfactory.

No person not well-versed in the theory, and experienced in the application and use, of instrument control, should attempt to select and install the control for an air-conditioning installation. Unless these controls are correctly chosen and installed, the equipment cannot be expected to maintain correct conditions. This is a job for the expert, and few, if any, food manufacturing plants are in a position to get along in this matter without retaining the services of such an expert.

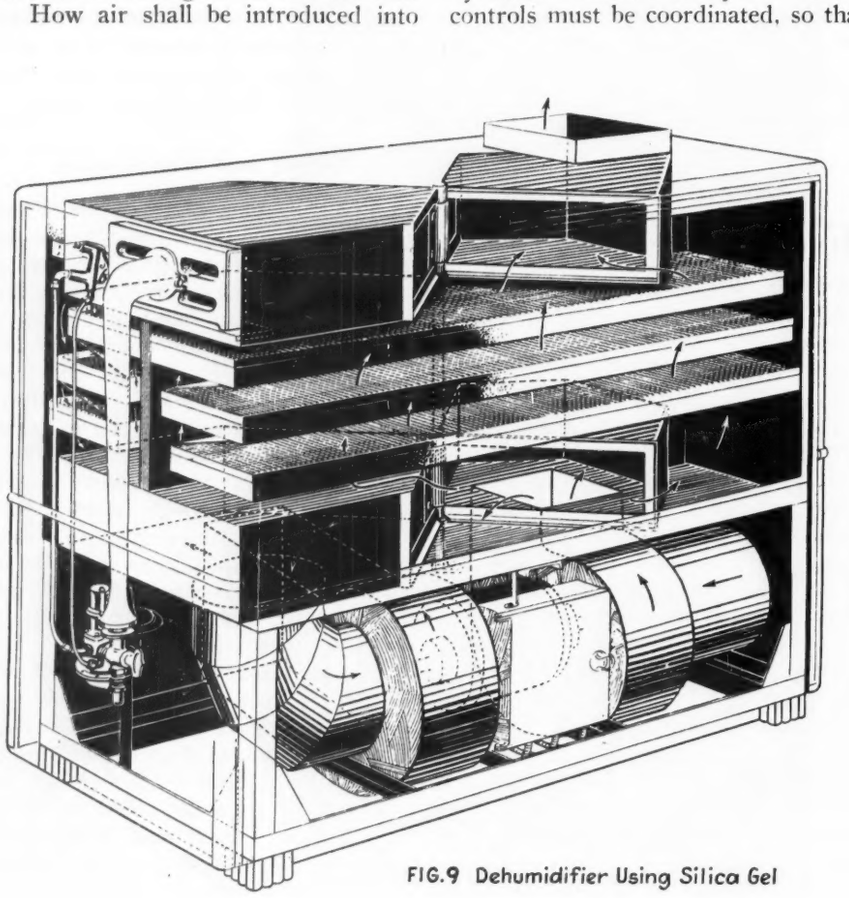


FIG. 9 Dehumidifier Using Silica Gel

Final Caution

THE purpose of the foregoing remarks concerning the equipment used for air conditioning is solely to acquaint the food engineer who is not already familiar with the equipment, with the purposes and main features of what is available from manufacturers of air-conditioning apparatus. No food processing or handling establishment should attempt to purchase or install this equipment without expert advice. There are already too many makeshift and ineffective conditioning installations in existence. These do their owners little or no good, are a waste of money, and only tend to discredit a unit operation which, if correctly used, is one of the most valuable tools available.

Controlled

Enzymes and the Storage of Perishables

By E. F. KOHMAN

Research Laboratories, National Canners Association, Washington, D. C.

This blanching operation is largely necessary to destroy enzymes.

MEAT, milk and eggs are no longer regarded as perishable in the same sense as are certain vegetables and fruits. The former may be taken at their prime and held under standardized conditions for practical periods that permit them to be distributed and consumed in their prime. Not so with a number of our most delicate vegetables and fruits. If certain vegetables are harvested when very young or succulent, their life processes are so active and bring about such profound changes during the time required for distribution that there is a temptation not to harvest them until coarse fibers have developed. Most fruits for shipment must be harvested before they obtain their ultimate in luscious ripeness, many still being distinctly green. Canning has a distinct advantage in such products inasmuch as canning is done promptly after harvesting, and in canning all normal life processes are arrested. For all practicable purposes, a perishable product has been converted into a stable commodity.

Our discussion might well center around those perishables whose handling man's ingenuity has not yet mastered. To begin with, the question may well be asked whether the cost of handling them is justified by the benefits they impart to our dietary. Not many decades ago the chemical composition of the human dietary underwent profound changes. Cereals were milled; vegetable oils were extracted and refined; almost chemically pure sugar was offered us in place of the sap of the cane or the beet.

Instinct so guides the animal kingdom in its food selection as to include all necessary requirements. It is not illogical therefore to expect that radical changes in the chemical composition of man's dietary should manifest themselves through his instinct. This is exactly what happened. Even before the close of the last century, when scientific nutritionists were being baffled in their attempts to concoct a satisfactory diet from the then-known food components — proteins, fats, carbohydrates, and certain mineral elements — the consumption of vegetables and fruits and dairy products was rapidly mounting. Twenty years ago when the vitamins were being discovered, the slope of the graph representing the consumption of vegetables, fruits, and dairy products was already pretty well established. It is now apparent that the chemical changes made in our dietary by the refining processes may be corrected by adequate vegetables, fruits and dairy products. This must be borne in mind in any consideration of the storage of perishables.

THE outstanding dietary essential supplied by succulent vegetables and fruits, the one essential that is scarcely obtainable from any other source, is vitamin C, i.e., ascorbic acid. Apparently the growing plant cell is the only original source of this substance. In any deteriorating change that these vegetables and fruits undergo, this component is among the first to suffer.

One phase of the deterioration and spoilage of perishables is the result of the activity of micro-organisms such as bacteria, yeasts, molds. The results of their activity is variously termed decay, rot, mold, which need not be included within the scope of our consideration. We will consider only the deterioration resulting from the normal or abnormal activity of the plant cell itself. The activity in the cells of the more complex plant structure is not greatly different from the activity of the simple plant cells that we term micro-organisms. Pasteur had a fairly clear recognition of this fundamental principle. The basis of the activities of all plant cells is to be found in their enzymes. It is from the standpoint of enzymic activity that our subject must be treated.

Considered from the amount of material involved, the most important thing that happens in a freshly harvested succulent vegetable is the burning or oxidation of sugar. This results from the normal respiratory process that goes on in every plant cell whereby oxygen is consumed and carbon dioxide is given off in a process similar to that occurring in the animal organism. The green leaf in the sunlight takes up carbon dioxide and gives off oxygen to the air. However, cut the green leaf off and bring it into the laboratory and only the reverse process is in evidence. To give some idea of the magnitude of

▶ *A knowledge of the rôle of enzymes is useful to those engaged in:*

Canning
Cold Storage
Fishing
Fruit and Vegetable Drying
Meat Packing
Pickling
Preserving
Produce Handling
Quick Freezing

Atmospheres

this burning to sugar, this table from Benoy's work is submitted:

Glucose Lost in Terms of the Per Cent of Dry Matter Present Calculated from Carbon Dioxide Evolved in 26 Hours at 30 deg. C.

Vegetable	Per cent Dry Matter	Per cent Lost (Glucose)
Asparagus	8.3	13.7
Lettuce	6.2	6.4
Green Beans	7.7	6.3
Okra	13.7	5.2
Green Onions	9.3	4.5
Carrots	13.9	3.2
Tomatoes	6.1	2.7
Beets	9.5	2.0
Green Mangoes (sweet pepper)	8.0	2.0
Red Pimiento (short, broad variety)	9.4	1.3

There is ample justification for the belief that sugar is not the only substance oxidized. Since the composition of vitamin C, i.e., ascorbic acid, is so closely related to that of sugar, it would not be surprising to learn that vitamin C might be oxidized by this so-called respiratory system. As a matter of fact, it has been shown that apples and cabbage in storage do lose an appreciable amount of their vitamin C content. These represent the more stable of the fruits and vegetables. Recently it has been shown that with the more perishable vegetables, such as peas and spinach, the vitamin C loss may be enormously greater in relatively short storage periods, particularly if wilting is permitted. This may be a simple oxidation by atmospheric oxygen, since vitamin C is similarly lost when cooked vegetables and fruits whose enzymes have been inactivated are spread in a thin layer and thus exposed to oxygen of the air. It may be said that practically all raw vegetables and fruits lose some of their vitamin C content during practical storage periods.

Under certain abnormal conditions, the enzymes involved in the respiratory process bring about normal reactions. Under such conditions, vitamin C destruction might be very rapid. For example, if the juice is pressed out of vegetables such as potatoes, carrots and cabbage, the vitamin C is so quickly oxidized that it is scarcely possible to feed it before its activity is materially lowered. This is not a question of days but of hours and minutes. Whenever vegetable tissue is bruised, such reactions may be expected.

WE have recently shown that the bruising of succulent vegetables may have a profound effect on the respiratory system. First, the bruised or ruptured cells tend to lose their vitamin C rapidly. Second, this macerated tissue does not use its normal oxygen requirement but nevertheless gives off carbon dioxide. This results in so-called anaerobic activity which is not normal and therefore results in abnormal byproducts. Frequently these are distinctly of undesirable flavor. Third, this macerated vegetable tissue is no longer porous and therefore cuts off the air supply of underlying cells and thus anaerobic respiration in the underlying tissue results.

In 1927-1928 we made a study of freezing vegetables and fruits, and reported that in the successful freezing of vegetables it would be necessary to inactivate enzymic activity as well as inhibit the development of micro-organisms. It was found impossible to freeze vegetables in the raw state and avoid the development of distasteful off-flavors. These have been shown to be the result of anaerobic activity induced by the bruising or rupturing of the plant cell by freezing. It was shown that by inactivating the enzymes with a short heat treatment, vegetables could be frozen and their normal characteristics retained. Costly attempts at freezing vegetables in the raw state on a commercial scale in subsequent years have amply demonstrated the soundness of our findings. Freezing may be considered as a case of 100 per cent bruising with enzymic activity almost completely anaerobic.

Anaerobic respiration in vegetable tissue was recognized by Pasteur. He brought out the fact that vegetables and fruits in an atmosphere containing no oxygen produced alcohol and carbon dioxide in the same proportion as they are produced in the fermentation of sugar by yeast, which is known to be an anaerobic fermentation. We know that simultaneously acetaldehyde is formed in relatively small quantities but that neither the alcohol nor the acetaldehyde accounts for the off flavors that develop in vegetables. Beyond this, there seems to be little known as to the products of the vegetable and fruit that enter into an anaerobic activity, or of the products that are formed.

Considerable is known, however, regarding the specific action on various products as judged by the ordinary senses by which quality is measured. Red apples, after four or five days in nitrogen or hydrogen, become bleached. So intense is the demand for oxygen that the oxygen is taken out of the color or pigment, thus bleaching it. In time, the apple becomes brownish, taking on a slightly baked appearance. The effect on peaches is similar. The characteristic aroma and flavor of both fruits are lost to a large extent. The amount of alcohol formed in peaches is sufficient to suggest brandied peaches. In an atmosphere of carbon dioxide, there is not the same tendency for the fruit to soften, although the flavor effects are undesirable.

THE tendency of fruits to remain firm in atmospheres of carbon dioxide is of significance and experimental work indicates, as discussed elsewhere in this issue, that a practical use may be made of a partial atmosphere of carbon dioxide. With vegetables, carbon dioxide appears also to have an inhibiting effect on the loss of sugar through the formation of carbon dioxide. Since sugar is one of our lowest cost food commodities, this is not of such importance as the effect in flavor.

Wherever delicate vegetables and fruits are handled, there are daily occurrences to indicate the undesirable effect of anaerobic conditions. Freshly picked red raspberries, stored for 24 hours under ideal refrigeration but in a tightly closed container, will lose much of their fragrance and aroma. Head lettuce, water-laden from being sprinkled, is stale—not because of the kind of water used but because this water cuts off the oxygen supply. Canners may frequently find it advantageous to make use of their cold water supply from deep wells to refrigerate for a few hours such products as tomatoes, peas and corn, and the development of off-flavors under such conditions forbids such a practice.

We may then conclude that:

1. It is desirable to harvest vegetables in their prime succulent stage and fruits in their most luscious stage of ripeness because of flavor and nutritional superiority.

2. Vegetables and fruits under these conditions are most perishable; the former because the very active respiratory or life process actually destroys flavor and nutrients; the latter, because these processes result in the breakdown of the fruit with resulting invasion by micro-organisms.

3. Cold storage temperatures only lower the rate of the changes that occur in raw vegetables and fruits. At present heat is the only known method for inactivating the enzymes. But heat alters the product and this is undesirable in the case of vegetables and fruits intended for raw consumption. Canning or freezing is necessary to avoid the ready invasion of a heated product by micro-organisms.

Controlled

Atmospheric Factors Affecting the Storage and Handling of Fresh Fruits and Vegetables

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THE fundamental consideration in the successful handling and storage of fresh fruits and vegetables is the fact that these products are alive and carry on vital biological processes much the same as before they were harvested. To a biologist, failure to appreciate this situation is as surprising as the fact thereof seems to be to many handlers and processors of perishable products.

Most important of these biological processes is respiration. Fruits and vegetables normally respire much the same as animals, taking oxygen from the air, giving off carbon dioxide, water and other waste products, and generating heat. The rate at which they respire marks the rate at which they live, and can be retarded or accelerated by the use of various means.

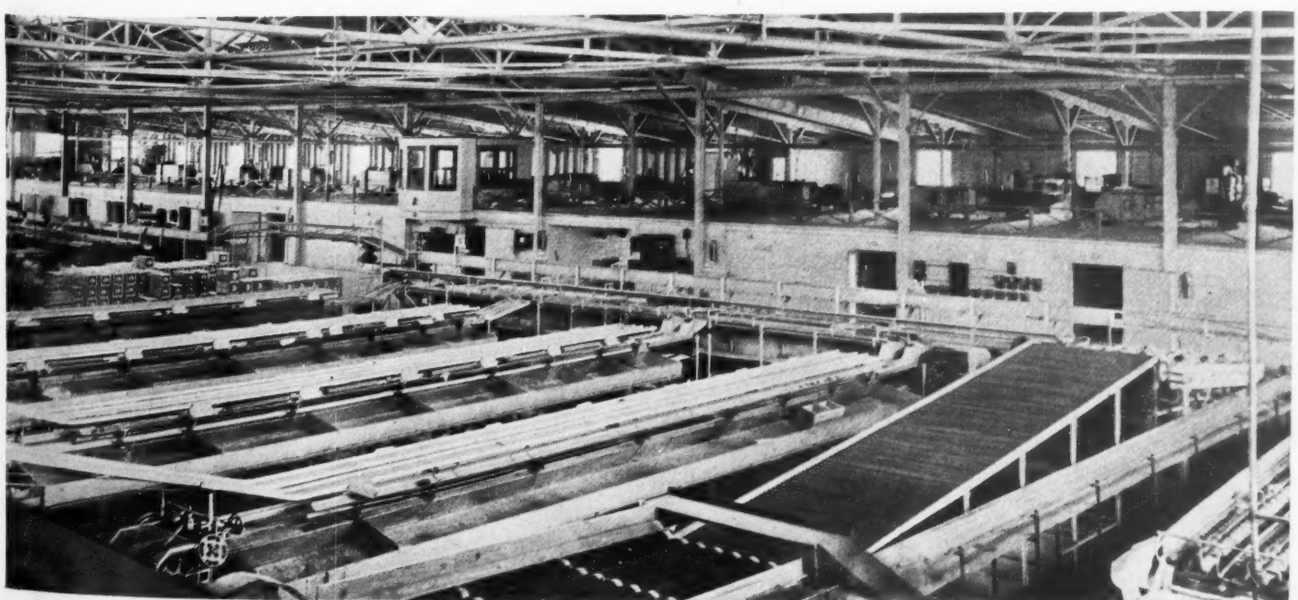
In respiration, the carbohydrates and acids (under some conditions) are gradually broken down until after a while these reserves are largely exhausted and an apple, for example, becomes overripe, mealy and practically worthless—succumbing to senility, if not previously destroyed by fungus rots.

Other biological reactions which continue after harvest and which are of importance to handlers and processors of these products have to do with softening or changes in the pectic constituents, changes in acidity which are important in a consideration of flavor, and changes in color.

Everybody is more or less familiar with the effects of cold storage temperatures in prolonging the storage life of fresh fruits and vegetables. For each kind of product there is a fairly definite optimum temperature which may be considerably above that at which they are damaged by freezing, or that at which they die because they cannot respire[1]. Above this optimum storage temperature, their rate of respiration in general doubles approximately for each rise of 18 deg. F., consequently their life expectancy varies inversely with the storage temperature.

But temperature control, while perhaps the most important factor, is not the only one to consider in long-time

[1]Rose, Dean H., Wright, R. C., and Whiteman, T. M. The commercial storage of fruits, vegetables, and florists' stocks. U. S. Dept. Agr. Circ. 279., 1933.



Inside the packing house of Florence Citrus Growers Association, Florence Villa, Fla., showing "coloring rooms" in which ethylene degreening treatment is given. Ethylene treatment lasts from 36 to 48 hours. The fruit is then washed and packed on machinery in the foreground, then precooled in rooms similar to coloring rooms, and next loaded into refrigerator cars.

Atmospheres

successful storage. To keep the products crisp and "fresh" the atmospheric humidity must be controlled at a fairly definite optimum. This optimum is, for most products, within the range of 85 to 88 per cent relative humidity, or roughly about the same as the per cent of moisture contained in the tissues of the fresh products. If the relative humidity of the storage air is allowed to fall below this optimum the products tend to dry out, wilt and shrivel, and if raised much above it they tend to mold and loss from rots may be increased. There are important exceptions to this, however, as will be noted in Table I. Leafy products, such as celery, require a higher humidity to keep them from wilting, while, on the other hand, onions must be kept drier to prevent them from forming roots.

THERE has always been much controversy over the necessity of ventilating storage rooms, particularly to keep carbon dioxide from accumulating. Some shippers of oranges instruct boat lines to ventilate the holds twice a day and under no circumstances to allow the carbon dioxide to accumulate above 0.5 per cent. Apple storages used to be ventilated religiously for the same purpose. The necessity for this practice of ventilation is now seriously questioned, both as to the possible injurious effects of the carbon dioxide and on account of difficulties involved in maintaining satisfactory temperature and humidity conditions. All the benefits of ventilation, minus its disadvantages, appear to be attainable by utilizing fans in the room to keep the air from becoming stagnant.

Today, in England, fruit is being kept in air-tight rooms, allowing the carbon dioxide from respiration to build up to approximately 10 per cent and the oxygen of the air to be reduced correspondingly. After this level is reached the rooms are ventilated as needed to maintain approximately the same ratio of carbon dioxide to oxygen, which induces an anesthetic effect on the fruit, slowing down all of its life processes. Most satisfactory results are obtained if the temperature is not allowed to go above 50 deg. F. Under the cool climatic conditions of England this means very little refrigeration to supplement the carbon dioxide treatment. In the United States, with our hot weather during much of the year, the saving in refrigeration costs would be inconsiderable. Too, the basic principle of gas storage cannot be recommended for general commercial consideration here because it depends upon shutting up individual lots to be handled as units. It would mean a multiplicity of small rooms and a complexity of operation that would be impractical under our conditions.

However, there is a possibility of utilizing carbon dioxide treatment to supplement refrigeration instead of using refrigeration to supplement carbon dioxide treatment. Studies by the Department of Agriculture[2] have shown that immediate retarding effects on life processes of fruits and vegetables can be secured by building up relatively high concentrations of carbon dioxide during the first day or two after harvest, while the products are being cooled by ordinary refrigeration. This is usually done by using a sufficient quantity of solid carbon dioxide and not for refrigerating effect. After the products are cooled to a satisfactory temperature, the carbon dioxide treatment can be discontinued and the ultimate effects are much the same as those procurable through immediate cooling, both on the physiology of the product and in inhibiting decay organisms.

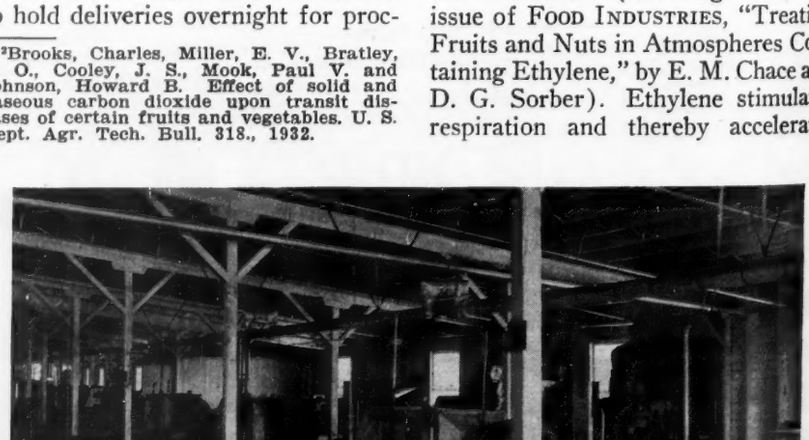
This method seems to offer greatest promise in shipments to be forwarded in refrigerator cars where precooling facilities are lacking and in canning factories where refrigeration facilities are not available and it is desired to hold deliveries overnight for processing next day. It would seem to have special application to such products as peas and sweet corn, which deteriorate in quality so quickly after harvest. The carbon dioxide treatment is very effective in preserving "quality" in these products.

Carbon dioxide treatment, of course, must be used with discretion, as must every anesthetic—too much kills the patient. There is quite a difference in the tolerance of different products to short treatments with relatively high concentrations of carbon dioxide prior to refrigeration, as indicated in Table II, which presents some of the results of studies along this line conducted in the Department of Agriculture.

The particular difficulty encountered in carbon dioxide treatments in refrigerator cars is accurately to control the concentration of the gas. Cars are not gas-tight: in fact, they vary greatly in this regard. New cars are much tighter than old ones and are therefore much more likely to smother their contents when gas treatments are attempted. Old cars, however, may be so leaky as to make impossible the maintenance of an effective gas concentration, especially while in transit.

IT is often desired to stimulate ripening or coloring processes. This may be accomplished by raising the temperature, but when even greater speed is required and under certain other conditions resort is had to ethylene treatment. (See Page 292, this issue of FOOD INDUSTRIES, "Treating Fruits and Nuts in Atmospheres Containing Ethylene," by E. M. Chace and D. G. Sorber). Ethylene stimulates respiration and thereby accelerates

[2]Brooks, Charles, Miller, E. V., Bratley, C. O., Cooley, J. S., Mook, Paul V. and Johnson, Howard B. Effect of solid and gaseous carbon dioxide upon transit diseases of certain fruits and vegetables. U. S. Dept. Agr. Tech. Bull. 318., 1932.



A row of air conditioning equipment on top of the coloring rooms at Florence Citrus Growers Association.

Controlled

Table I: Recommended temperature and relative humidity for storage of the principal fruits and vegetables with their average freezing points.

Product	Temperature, deg. F.	Relative humidity, per cent	Average freezing point deg. F.
FRUITS			
Apples	31 to 32	85 to 88	28.4
Cherries	31 to 32	80 to 85	27.8
Cranberries	35 to 40	90 to 95	27.2
Grapefruit	50	85 to 90	28.4
Lemons	50 to 55	80 to 85	28.1
Oranges	34	80 to 85	[1]
Peaches	31 to 32	80 to 85	29.4
Pears	30 to 32	85 to 90	[1]
Plums (including prunes)	31 to 32	85 to 90	28.5
Quinces	31 to 32	80 to 85	28.1
Raspberries (red)	31 to 32	80 to 85	30.4
Raspberries (black)	31 to 32	80 to 85	28.8
Strawberries	31 to 32	80 to 85	29.9
Nuts	32 to 35	75 to 80	[1]
VEGETABLES			
Beans, green or snap	32	85 to 90	29.7
Beans, lima	32	85 to 90	30.1
Cabbage	32	90 to 95	31.2
Carrots (topped)	32	95 to 98	29.6
Carrots (bunch)	32	95 to 98	....
Cauliflower	32	85 to 90	30.1
Celery	31 to 32	95 to 98	29.7
Corn (green)	31 to 32	85 to 90	29.0
Cucumbers	50 to 60	85 to 90	30.5
Garlic (dry)	32	70 to 75	25.4
Horseradish	32	90 to 95	2o.4
Onions	32	70 to 75	30.1
Parsnips	32	90 to 95	28.9
Peas (green)	32	85 to 90	30.0
Potatoes	36 to 60	85 to 90	28.9
Rhubarb	32	90 to 95	28.4
Squash (winter)	55 to 60	70 to 75	29.3
Sweetpotatoes	50 to 55	80 to 90	28.4
Tomatoes (ripe)	50 to 55	80 to 85	30.4
Tomatoes (mature green)	55 to 70	80 to 85	30.4

[1]The figures for oranges are Florida (Valencia), 28.3; California (Washington Navel), 27.7. For pears—Bartlett, 28.5; Winter Nelis, 27.3; Anjou, 26.9; and for Persian (English) watnuts, 20.

Table II: Tolerance of certain fruits and vegetables to relatively high concentrations of carbon dioxide prior to refrigeration.

Product	Temperature deg. F.	Per cent carbon dioxide: Initial	After 24 hrs.	After 48 hrs.	Effect
Apricots	50	25	25	..	Flavor lacking
Apples (Jonathan)	50	50	25	10	Normal flavor
Pears (Bartlett)	50	50	25	10	Normal flavor
Peaches	50	25	25	..	Flavor lacking or objectionable
Strawberries	50	40–80	10	..	Normal flavor
Strawberries	50	40–80	25	10	Flavor impaired
Dewberries	50	40	40	40	Normal flavor
Blackberries	50	40	40	40	Normal flavor
Raspberries	50	25	25	..	Flavor lacking
Blueberries	50	40	40	40	Normal flavor
Cherries	50	40	40	40	Normal flavor
Currants	50	40	40	40	Normal flavor
Plums (Italian Prunes)	50	40	40	40	Normal flavor
Grapes	50	40	40	40	Normal flavor
Oranges	50	40	40	40	Normal flavor
Tomatoes	50	40	40	40	Later ripening sometimes affected
Peas	50	40	40	40	Normal flavor
Sweet corn	50	40	40	40	Fresher and sweeter than untreated
String beans	72	30	30	30	Normal flavor and condition
Lima beans	50	40	40	40	Normal flavor and condition
Cauliflower	72	30	30	30	Better flavor than untreated
Carrots	72	30	30	30	Better flavor than untreated

ripening processes. It also destroys chlorophyll but it has not been demonstrated that it affects other pigments or otherwise influences the quality or condition of the products. Ethylene is produced in minute quantities by certain fruits, especially apples, pears and bananas, and there is a likelihood that it is also produced by other fruits, indicating that it may be a natural stimulant of the ripening processes.

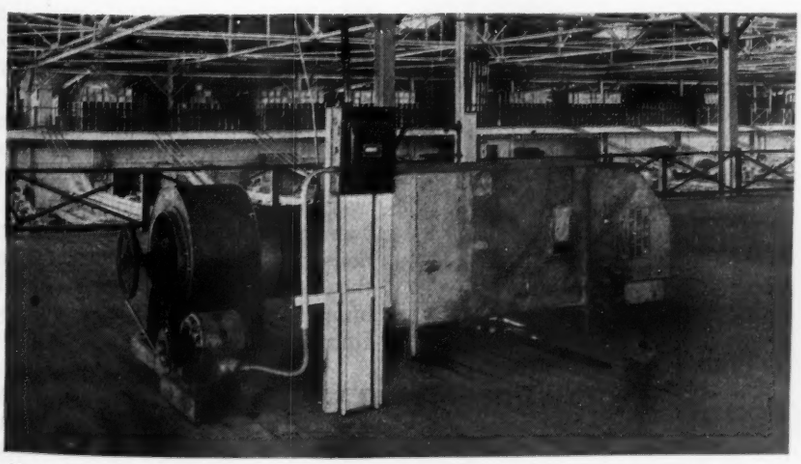
The specific reaction to ethylene seems to depend upon the character of the product treated. Products with a carbohydrate reserve, like pears and bananas, can be actually ripened by the treatment. In products without significant carbohydrate reserves, such as tomatoes and citrus fruits, the effects are most apparent in color changes and the sugars and acids are not measurably affected.

It will doubtless be of interest to indicate the extent to which atmospheric factors are controlled in the commercial handling of fresh fruits and vegetables.

Attempts are made almost universally to control humidity in order to keep products from wilting and preserve their "fresh" quality. In cold storage plants this is done by various humidifying devices or by employing the brine spray system of refrigeration. In the transportation and storage of leafy vegetables like spinach and lettuce, it is accomplished by packing the products with crushed ice between the layers and shipping under top ice, the melting of which not only furnishes refrigeration but increases humidity as well. Humidity is reduced by ventilation or by fanning the air of a storage room over calcium chloride. In direct expansion cold storage systems, difficulty is encountered in maintaining the desired humidity because of the freezing of atmospheric moisture on the coils.

AMERICAN handlers of fruits and vegetables have thus far been more interested in getting rid of carbon dioxide than in using it. Abroad, carbon dioxide or "gas storage," as it is called, has assumed commercial significance, but in this country as yet it has been used only experimentally. A few years ago there was a large scale commercial experiment in the gas storage of citrus fruit in Florida, but it ended disastrously. However, there is a growing interest in the possibilities of carbon dioxide treatments, and it is probable that for specific purposes and under certain conditions they will eventually find adaptation to commercial use in this country.

Ethylene treatment is universally used on citrus fruit in this country and in most of the commercial producing districts abroad. It is used to some extent also in the ripening or coloring of other products.



Close up of one of the air-conditioning units which controls temperature, humidity, ethylene and air movement.

Atmospheres

Treating Fruits and Nuts in Atmospheres Containing Ethylene

Four aspects of atmospheric control are involved here: ethylene control, carbon dioxide control, temperature control, and humidity control

By E. M. CHACE
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THE GENESIS of the ethylene process of treating fruits, like many other practices now in use, is shrouded in the myths of the past. It is written that centuries ago the Chinese softened winter pears by storing them in rooms where incense was kept burning. In California, the effect was first obtained in the early days of the citrus industry when kerosene stoves were used as heaters in packing sheds and fruit cars to keep the fruit from freezing.

Inevitably it was noticed that the heated fruit was better colored than that packed when, owing to weather conditions, heat was not used. Naturally the conclusion was drawn that heat was the causative agent. One steam-heated storage room served to dispel this idea and thereafter kerosene stoves were in constant use in coloring rooms for oranges, lemons and grapefruit. In 1912, Sievers and True conclusively proved that the combustion gases from those stoves contained the active gas or gases.

It remained for Denny to find that ethylene was the compound responsible for the desired effect. His work was carried on from 1921 to 1923, reported to the Lemon Men's Club in their October meeting in 1923, and a patent covering the process issued in 1923. Since then Denny's coworkers in this laboratory and many others have broadened the field in which the original process had been recommended.

From the very first, it was noted that better results could be obtained if the coloring room were thoroughly ventilated at frequent intervals, not further apart than each twelve hours, often after each six hours. Denny had already discovered and published the fact that with citrus fruits the respiration was greatly accelerated, sometimes as much as 200 per cent. It seemed therefore not unreasonable that the excess of carbon dioxide and other gases, including water vapor, should be removed as often as convenient. Other workers found that with 1 per cent carbon dioxide, the coloring was retarded, and that above 2 per cent there was a harmful effect on the oranges. The rule of plenty of ventilation was preached throughout the citrus industry.

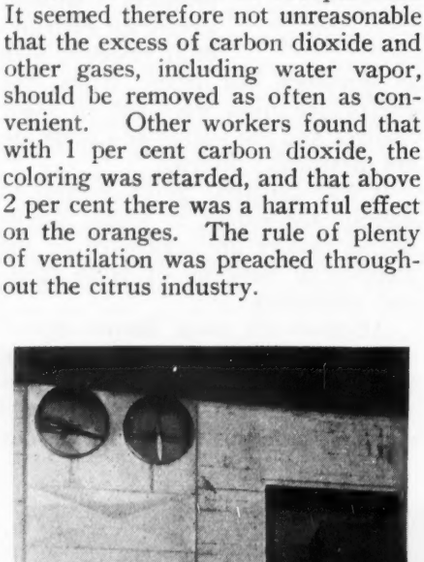


Fig. 1: Interior of a citrus coloring room for ethylene treatment showing fans, ventilators and cooling system.

In order to ventilate, it was necessary to waste heat, and the question of the optimum temperatures and percentages of relative humidity were soon being discussed. Temperature was a factor that could be controlled with relative ease, but the control of humidity was a more difficult problem. It can be adequately controlled of course, but the apparatus is more complicated and costly than in the case of temperature control.

TEMPERATURE CONTROL: Experimental work had shown that the rate of coloring of citrus fruits was very slow, where the temperatures of the coloring rooms remained below 60 deg. F., that the best results seemed to be obtained at from 70 to 80 deg. F., and the poorest where the temperatures were allowed to go beyond 90 deg. F.

HUMIDITY CONTROL: Control of relative humidity was not attempted at first; the humidity was kept sufficiently high to avoid wilting the fruit and yet low enough to prevent condensation of water on it. Water was placed on the heaters when it was thought to be too low, and the rooms were ventilated when condensation was taking place. Later the desirable percentage of relative humidity, at least for citrus, was found to be about 90 per cent.

ETHYLENE CONCENTRATION: Denny found that he could color black-green lemons with concentrations of ethylene gas as low as 1 part in 2,000,000. In actual practice 1 part in

Controlled

10,000 was used, but in measuring the volume of the coloring room, no account was taken of the volume of fruit in the room so that in reality the concentration, at the time the gas was run in, was above 1 part in 5,000 in most cases. That the amount of gas decreases very rapidly either through leakage or absorption by the fruit is apparent from determinations of the combustible gases before and after charging.

Commercially, ethylene is obtained in cylinders containing from 2 to 30 lb. One pound is equivalent to 13.4 cu.ft. under usual atmospheric conditions. The gas is measured with a regulator and meter which can be set to deliver a desired volume in a given length of time. The flow is usually carried to the center of the room and released, diffusion being left to natural properties of the gas, its specific gravity being relatively that of air.

Later devices for distributing the gas to a series of rooms consist of what is commonly known as "trickle systems." Here a continuous flow gage is used, the flow often being measured by counting the bubbles of gas passing through a bottle containing water. By this means a constant flow of air through the rooms is maintained and this air may be conditioned as to temperature, humidity and ethylene content before it enters. Where air is recirculated to economize on heat, ethylene should be admitted at regular intervals or the bubble-rate cut down so it may not increase above the desired amount. It is well also to provide for diluting the respiration gases from the fruit with fresh air as the carbon dioxide will otherwise increase above the safety point. The usual methods of determining ethylene are by means of a Hoolamite tube ($I_2O_5+H_2SO_4$, fuming on pumice), such as is used in mines for detecting carbon monoxide, or by the electrical resistance methods similarly used.

There seems to be a difference of opinion as to whether fruit can be injured by excessive quantities of ethylene. So far as we can ascertain, there have been no carefully planned experiments, the results of which indicate that such is the case. There have been undoubted cases where fruit was injured during coloring, but direct evidence is usually lacking as to the cause of the injury. Temperature, humidity, carbon dioxide content of the atmosphere in the rooms and treatment of the fruit between the time of packing and placing in the coloring rooms are all factors which must be considered. It is difficult to plan experiments where all but one of these possible factors can be eliminated.

Fig. 2: Trickle system of controlling ethylene addition to atmospheres in rooms is adjacent to the air-conditioning equipment. Ethylene from the cylinder bubbles through water in the several "bubble bottles" on its way to the corresponding rooms.

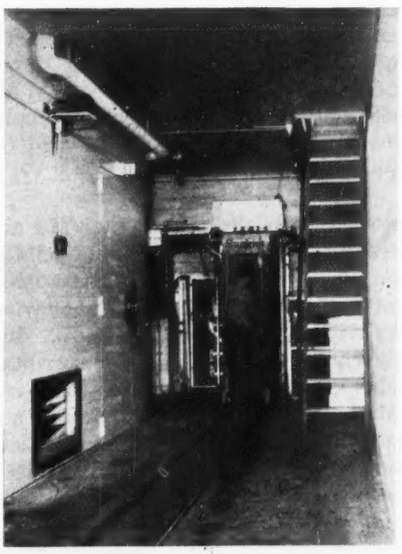


Fig. 3: Corridor in citrus packing house showing ventilators and fan-motors.

APPLICATION IN THE CITRUS INDUSTRY: The method has been carried out under many variable conditions. Boxes or sacks of fruit have been stacked in the open, covered with canvas and the gas run under it. Obviously a location sheltered from the wind and frequent recharging may be necessary under these conditions.

A great number of citrus coloring rooms are gas tight or nearly so. Into these, large stacks of fruit in boxes are closely crowded. The rooms can only be ventilated through the door and roof, and the boxes of fruit are stacked in contact with the floor, the heat being supplied by electric space heaters. Circulation is of course very poor, so that the top rows of boxes are subject to 10 to 20 deg. F. greater temperature than those at the bottom of the stack. A few coloring rooms, usually in houses that handle lemons as well as oranges and grapefruits, have modern installations where the air is conditioned as to temperature, humidity and ethylene content, as in Figs. 1, 2 and 3. Either water spray or steam is used for humidifying. The air is heated by steam coils or space heaters, or cooled by circulating water at 40 deg. F., which in turn is cooled by refrigeration coils. There are not many of these installations, and so far as we know, they are confined to the citrus industry.

USE BY WALNUT GROWERS: In California, next to the citrus packing plants, the walnut growers are the largest users of ethylene. Here the purpose of the process is to loosen the hulls on nuts in which the kernels are mature but to which the hulls are still tightly attached. Treatment with ethylene will loosen these stick-tight hulls in from 36 to 60 hours. The nuts are usually treated in bins which have slatted bottoms, and should not be over 8 ft. deep. It is desirable but difficult to keep the humidity down. Excessive humidity promotes bacterial decay of the hull which often results in darkening and frequently molding of the kernel, causing the nut to be classed as a cull. The temperature range is between 60 and 90 deg. F. Below 60 deg. F., the rate of loosening is retarded and the same occurs to a lesser extent above 90 deg. F. The ethylene is used at the rate of 1 part to a thousand parts of air. So far there is no evidence to show that excessive amounts are harmful, nor do we know at this time the effect of excessive quantities of carbon dioxide. The indications seem to point to rapid handling from the time the nut is shaken down from the tree

until it is finally dried to the proper moisture content, as the most important factor in securing quality.

TREATING PEARS AND MISCELLANEOUS FRUITS: In the case of pears, tomatoes and Japanese persimmons (the Kaki), the equipment is usually less complicated than with either citrus fruits or walnuts. The pears and persimmons are often covered with canvas after the boxes are stacked in a shed away from the wind. They are gassed in the usual way.

The pears will color and soften in five to six days and do so uniformly, whereas in the regular ripening cellars from ten days to two weeks is needed at the beginning of the season, with from one to seven sortings. Sorting costs in some canneries, which varied from $1 to $2 per ton, have been eliminated. The cost of treatment is about 10 cents a ton, and depends somewhat on the nature of the set up used. Extra trucking costs are often the greatest factor. The optimum temperature for pears is 70 to 80 deg. F., with humidity sufficiently high to prevent wilting.

Persimmons are usually treated under canvas without special precautions. They color and soften in about 48 hours. After treatment they cannot be shipped for long distances but will stand up well enough to be shipped by truck to the local markets. The astringency of this fruit is removed by the treatment, the removal being more uniform than where it is softened in ordinary storage.

Success with tomatoes depends more on the proper harvesting than on the subsequent treatment. If harvested at the proper stage of maturity, several days time may be saved in getting good color for the market by treating with ethylene. The treatments are carried out under canvas, in refrigerator cars or treating rooms as may be most convenient. Conditions are about the same as for other fruits.

Blanching celery with ethylene has been advocated by some shippers. The success depends somewhat on the variety treated. The non-blanching types in California and Utah are not affected by the treatment. The temperatures best suited for the treatment are between 60 and 70 deg. F., and the length of the treatment, 24 to 48 hours. As board blanching of celery increases the heart size somewhat, it has that advantage over gas.

Ethylene can be used for bananas, where there is need for speeding up the coloring process. Manifestly it would be of little use during transportation of the fruit as it is desirable to have it arrive hard and green. On chilled fruit, it is said to be used to advantage. Temperatures are kept above 60 deg. F. with high humidity. The usual coloring rooms are used where the treatment is carried out commercially. The fruit is said to color more uniformly where gas is used, the time required depending upon the maturity. With fast ripening fruit, no gain or only an insignificant one can be expected.

A few lots of peaches and apricots have been treated experimentally. The Montgamett, and to some extent the Alameda Hemskirk apricots, which have a tendency to ripen on one side before the other, can be made to soften uniformly by 48 hours treatment with gas at the usual concentration and temperature not to exceed 80 deg. F. Care is necessary in harvesting and in keeping down the humidity during treatment. With both apricots and peaches, mold growth has to be closely watched or considerable loss may ensue.

NATURE OF THE REACTION: The action of ethylene on plant cells is not clearly understood. It is apparently closely connected with enzyme activity but whether this is due merely to a change in the permeability of the cell wall or to some catalytic effect on the enzyme is not known. In some ways ethylene acts very much like a plant hormone or auxin. It is now well established that it is a natural constituent of the respiratory gases of fruits in storage and is given off by fruits and vegetables generally when they are injured. Even before these discoveries, it was well known that the gases given off by decaying fruit or even ripe fruit would act similarly to ethylene. In storing lemons, it has been known that the fruit in boxes adjacent to those containing decayed fruits would color sooner than that in boxes not so located. In fact, some pear canners place boxes of ripe pears in the stacks of green fruit in order to hasten the desired softening and coloring changes. The changes brought about by the gas take place only in the living cell; similar changes do not occur when the reactive materials are brought together outside the living organism. Furthermore, the reactions are selective; decomposition of chlorophyll takes place in coloring fruits and there seems to be deepening of the yellow pigments, and with tomatoes a hastening in the development of the red colors. There is, however, no apparent effect on the red pigments of cherries, strawberries or apples. The conversion of starch in pears and bananas takes place more rapidly than it is accomplished by storage, but in most cases the inversion of cane sugar is not accelerated. Tannin compounds are destroyed or made insoluble in persimmons, but not in olives or walnut hulls.

As far as we have been able to discover, the ethylene treatment brings about no changes which do not occur naturally in the fruits; it merely speeds up natural reactions. Whether the reactions taking place naturally are activated by the ethylene normally present in the fruits cannot be said at present. The fact that ethylene is present and apparently takes part in the normal functions of plants, and that no reactions not common to natural ripening have been found, should go a long way in answering criticisms on the use of this gas in coloring.

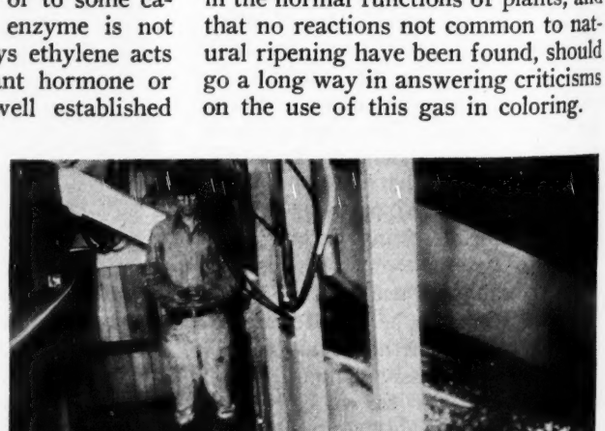


Fig. 4: Walnuts in bins ready for ethylene treatment inside the shed.

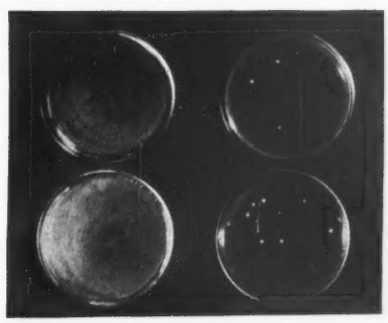
Controlled

Mold and Bacteria Killed by New Lamp

Germicidal irradiation may revolutionize practices in meat, baking, dairy, beverage and other industries.

By ROBERT F. JAMES
Research Department, Westinghouse Lamp Co., Bloomfield, N. J.

Two short loins of beef after ageing by the usual method (left) and under ultra-violet radiation. Note scarcity of mold on loin at right.



Culture dishes showing growth of organisms in meat display cases. Those at left were taken in case equipped with ultra-violet lamps and show no growth. White specks on those at right are colonies of growing bacteria. All were exposed five minutes in the air.

OUT of photochemical research on the case-hardening of steel has come a discovery that may revolutionize many industrial practices. Especially important is this discovery to the food industries, for it provides a means of killing all types of bacteria and mold spores by a low-power, low-temperature, low-cost, ultra-violet lamp.

Nine years of experimental tests and practical applications have definitely established the effectiveness of the germicidal radiation from this lamp in preventing growth of mold and bacteria on the surface of meat aged at high temperature and high humidity, and in retarding the growth of mold on bakery products. Tests indicate that the lamp can also be used to sterilize conditioned air and to "pasteurize" milk and beer.

The lamp which does all this is a gaseous-conductor tube, called the "Sterilamp,"* that generates radiant energy of a particular wave-length, 90 per cent of the radiation being in a region of the radiant spectrum which is strongly germicidal. The Sterilamp, made in lengths of 10, 20 and 30 in., requires only 7 watts of electrical energy for the 20-in. size. Of great importance in many food-field applications is the fact that the unit operates at a temperature only 4 or 5 deg. above room temperature.

NASMUCH as the radiation from this lamp promises to solve one of the important problems of the meat industry, an installation was made in the plant of Nathan Schweitzer Co., Inc., New York, a year ago to check its performance under practical operating conditions. In the beef storage room of this plant, a small space of about 500 cu.ft. was partitioned off and seven lamps installed. And instead of being cooled, the space was heated to 50 deg. F. to speed the enzymatic action which tenderizes the meat. Even at the high temperature, neither mold nor bacteria grew on the meat, and the cuts were aged in five days to a tenderness which formerly required five weeks. Prominent New York chefs sampled it and reported, "Good!"

Following completion of the work at Schweitzer's, an experimental application on a much larger scale was made at Merchants Refrigerating Co., New York, in cooperation with Beinecke Ottmann Co., a hotel supply house. Eight lamps were installed in a room measuring 18x8½x12 ft., four of the lamps being placed at each end of the room. This room was maintained at a temperature of 55 to 58 deg. F. and a relative humidity of 90 to 100 per cent, and as much as 1,400 lb. of beef was aged at one time. Compared with the three to five weeks formerly required for ageing the meat, only three or four days were needed under the Sterilamp at the high temperature and humidity. The shrinkage, or weight loss, amounted to only a little more than one-fourth of 1 per cent. As for trimming waste, there was none other than that incurred in removing the darkened surface. There was no growth of mold or bacteria.

IN THE baking industry, the new ultra-violet lamp has been put to practical use by two large companies, and it has been employed successfully on a test scale by a few smaller concerns. Kroger Grocery & Baking Co. has been using the lamp at its Columbus, Ohio, plant to retard mold

*Trademark.

Atmospheres

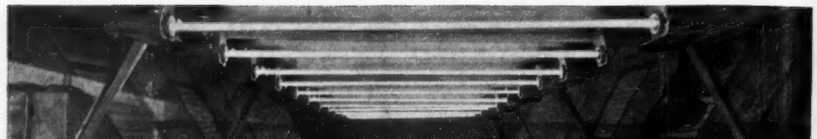
growth on fruit cakes. In its "Hostess" plant at Hoboken, N. J., Continental Baking has an installation to treat other types of cakes. In October, 1934, Kroger "sterilized" 250,000 of the cakes by passing them under a battery of lamps, with results so satisfactory that the company repeated the treatment last fall with a similar volume of production. Kroger now is working on further applications in its own laboratories.

Some idea of the effectiveness of the lamp at the Kroger plant may be had from these facts: Before the lamps were installed, spoilage on the cakes amounted to about 15 per cent. After exposure to the radiation and after certain changes had been made in the baking set-up, spoilage fell to a trifling 1 or 2 per cent. Most of this improvement has been credited to the lamps.

Continental Baking has installed the lamps on a cake wrapping machine. In operation since last August, this is a full-fledged commercial application on a production line that turns out several thousand cakes daily. Exposure to the rays has lengthened the mold-free life of the product from 1½ to 2 days, under the most adverse conditions. Adaptation of the process to bread slicing and to bakery air conditioning is contemplated.

As to the details of Continental's installation, eight of the 20-in. lamps are mounted over the intake conveyor to give an exposure of about five seconds to the cakes. Another battery of twelve lamps treats the wrapping material on the side which comes in contact with the product, the material being exposed to the rays as it feeds from the roll into the machine.

Previous to the installation of the Sterilamps in large baking plants, small-scale experimental work was done on the production lines in three smaller bakeries. One of these bakeries put the effectiveness of the radiation to severe tests with English muffins. High in moisture content, this product spoils quickly, and the muffins have been sold for the most part by retail bakers, who can deliver them direct to consumers. But after killing the mold spores on the surface of the muffins and on the wrapping material, the baker in question was able to send them out on cake trucks which delivered only three times a week. The procedure was to cool and package the muffins under the lamps. Another of these bakers employed the lamps to kill mold on bread.



Cakes being cooled under ultra-violet lamps at the Columbus, Ohio, plant of Kroger Grocery & Baking Co. This reduces spoilage by mold growth.

Beef is aged in three or four days in a room equipped with ultra-violet lamps, the temperature being maintained at 55 to 58 deg. F. and the relative humidity at 90 to 100 per cent.

In the matter of potential savings to the baker, the lamp affords an opportunity to cut deliveries to one every two days, or longer, instead of once a day, and to maintain bread in a mold-free condition for a longer time in the hands of the consumer.

MANY food manufacturers will be interested in the effectiveness of this special radiation in purifying conditioned air. While little has been done on this in a practical way, laboratory tests have shown that air can be rendered sterile to a high degree. The method is to install several tubes inside the air duct. Laboratory results indicate that an exposure of 1.2 seconds will kill 90 per cent of the bacteria in the air. To obtain 80 per cent sterility in air moving through a duct at a rate of 200 cu.ft. a minute requires two lamps. Air in a particular location may be kept sterile by installing lamps over that spot and flooding it with the radiation.

Two interesting potential applications of irradiation in the food plant are for the treatment of milk and beer. At the present time, the research department of Sheffield Farms Co., New York, is experimenting with the lamp in pasteurizing milk without heat, the milk being flowed in a thin film over an inclined surface under a battery of lamps. Preliminary tests have revealed that 90 per cent of the bacteria in the milk is killed, and it is expected that a kill of 99 per cent will be attained.

IN the laboratory, the bacterial count of milk was brought down to a count equivalent to that for pasteurized milk on an exposure of five to six seconds. Successful results likewise were obtained with beer.

Still another unusual possibility is insect control. The common housefly is attracted by the radiation and remains in the area of exposure long enough for the rays to have a lethal effect, which is 1½ minutes. The radiation repulses fruit flies, roaches and grain weevils, these insects refusing to enter the area of exposure.

Of particular interest to those engaged in food distribution is the fact that this lamp produces several beneficial effects when installed in cold storage rooms and display cases.

Controlled

Lamp-equipped boxes for cold rooms in which the temperature remains at 55 deg. would permit rapid tenderization of meat, enabling the retailer to buy cuts green and sell them tenderized.

Experiments with display cases and store coolers have brought results which may improve retail sales conditions. Tests were made in three 8-ft. cases, each containing the various cuts and kinds of meat ordinarily sold in the store. One case was operated under the normal conditions of 42 deg. F. and 50 to 60 per cent relative humidity, without lamps. A second was kept at the same temperature and humidity, but was equipped with two 30-in. lamps. The third was operated at a temperature of 60 deg. F. and a relative humidity of 90 per cent and was equipped with two of the lamps.

With the exception of one product, ground meat, the products in the high-temperature and high-humidity case had a better appearance after a period of a day or more than those in either of the other cases, with the meat in the low-temperature case equipped with lamps coming out second best. The ground meat darkened somewhat in color at the surface, a condition attributed to the direct irradiation and considered preventable by shielding the product with glass. As for shrinkage, the meat in the high-temperature, high-humidity case showed an average loss of 3.07 per cent in 48 hours, as compared with 3.93 per cent in the "normal" case.

Bacteria counts on pork chops, to take one product as an average example, showed five colonies on the top surface of the chops in the high-temperature, high-humidity case after eighteen hours. This compares with three colonies in the case operated at normal temperature and humidity but with lamps, and eleven in the "normal" case.

Aside from the quality and shrinkage of the products, benefits through the use of lamps in display cases kept at high temperature and high humidity accrue in the form of saving in power due to a much lighter refrigeration load and in the saving of labor which comes from not having to take the meat out of the case at night and put it back next morning.

NOW that the general field of application for this bactericidal and fungicidal lamp has been touched upon, more details can be presented on its use in the meat industry, the field where it has particularly far-reaching potentialities. Of primary importance, of course, is the elimination of the huge trimming loss incurred with ripened meat, the only trimming necessary when the meat is aged under the lamp being the removal of a dark surface film. Loss of weight is largely eliminated by a humidity of 90 per cent or more. In present commercial practices, losses amount to about 30 per cent from slaughterhouse to table. So great is the waste on high-hung beef that only diners at high-class hotels and restaurants can afford to eat it.

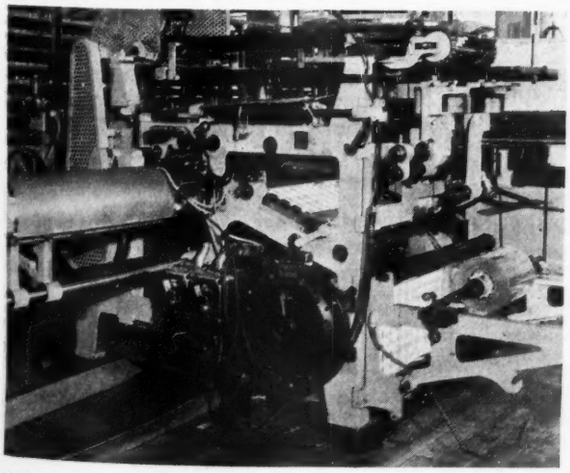
Nor is waste elimination the only saving. If the meat be stored at 50 deg., instead of the 35 to 38 deg. ordinarily used, there ensues a big saving in refrigeration. Moreover, at the higher temperatures permitted by the bactericidal and fungicidal action of the lamp, beef will ripen in about one-third or one-fourth the time, reducing the amount of storage space required. With this method it may even be possible to tenderize beef in transit from Chicago to New York, and the cost of ripened meat may be reduced to a point where consumption can be materially increased.

In considering the use of these lamps in his cold storage room, the packer no doubt wonders what happens to the meat on the side away from the lamp. The light is effective there, too. In tests, only a slight "fuzz" of mold developed on the "shaded" side of carcasses, this being not more than $\frac{1}{64}$ in. long. Bacteria likewise was effectively controlled in the "shade." The probable explanation of this phenomenon is that the radiation, being on one of the resonance spectral lines of oxygen, activates the atmosphere by ionization so that it holds its bactericidal and fungicidal charge. This effects an acceleration in metabolism, inducing the mold to grow suddenly and then die. Later work has shown that even a slight fuzz of mold can be prevented by circulating the air in the room with fans, thereby bringing the ionized atmosphere in contact with all the surfaces of the meat.

In considering the action of this new lamp which produces highly germicidal rays, cognizance must be taken of the fact that this is a special narrow band of the radiant energy spectrum and not a general ultra-violet radiation. Portions of the latter promote development of rancidity, but with the special germicidal band of radiation a bactericidal and fungicidal effect is produced before any rancidity is caused, thereby avoiding detrimental effects.

It is also important to understand that these germicidal rays have little penetration, their effect being primarily on the surface. With living tissue, the penetration amounts to 1 to $1\frac{1}{2}$ mm.; with meat, $\frac{1}{2}$ to 1 mm.; milk $\frac{1}{2}$ mm. Tests with water have revealed that the rays will penetrate 15 to 20 cm. of water with no decrease in intensity. As to length of exposure, 42 seconds is sufficient to give a 98 to 99.9 per cent kill of B. coli, streptococcus, and staphylococcus.

One of the factors favorable to commercial application of the lamp is its low cost, not only as to operation, but as to first cost and maintenance. The only necessary auxiliary equipment needed is a transformer. Two to four of the lamps may be operated from one transformer. The power taken by two lamps, plus that consumed by a transformer, amounts to something less than that required to operate an ordinary 25-watt incandescent bulb.



Automatic cake wrapping machine in Hoboken, N. J., plant of Continental Baking Co., equipped with ultra-violet lamps to kill mold on cakes and wrapper. Lamps which irradiate cakes are under hood over intake conveyor at left.

Company Gets Better Plant Location

Medium temperature and low humidity control enables essential oils concern to concentrate business on the upper floor of a modern building.

By F. H. LEONHARDT

President, Fritzsche Brothers, Incorporated, New York, N. Y.

MECHANICAL means of reproducing cellar or sub-basement uniformity of temperature and, in addition, a low humidity on the twelfth floor of a new, fireproof loft building has enabled us to move our essential oils plant out of a congested high-cost area.

The economies effected permitted us several advantages: (1) location of our business in a more pleasant and cleaner district; (2) better working conditions for our employees; (3) grouping our plant, laboratory and office activities on one floor and in convenient relationship to each other; and (4) installation of equipment and fixtures of latest type and design.

When the fire of more than a year ago forced a change of location from a highly favorable site we had occupied for more than 27 years, real estate brokers were able to locate only two or three sites in the downtown area of New York City which offered any possibilities for our use.

Disadvantages of these sites so greatly overbalanced the advantages that we decided to look into the possibilities of mechanical control over air in restricted areas to get the conditions we needed in our plant. Through the architects, Clinton & Russell, and engineers of Carbondale New York Co., we learned that we could get what we wanted on the twelfth floor of the Port of New York Authority Building at a cost which would be more than amortized by the savings during the life of a fifteen-year lease.

At this location we are safely above the level reached by street dust and insects, have more than a 30-per cent saving in rent, save $1.21 per $100 evaluation in fire and water damage insurance, and eliminate almost completely the use of artificial lighting.

The ventilating and temperature-controlling system which makes our occupancy of this location possible is essentially an air-waterspray condensing refrigerating unit hooked up to filters, fans, and ducts with capacity to handle from 18,000 to 22,000 cu.ft. of air per min. All units are under automatic temperature and damper regulator control of the air pressure type. These units circulate from 12,000 to 14,000 cu.ft. per min. of 68 to 70 deg. F. air through the stock or storage room and from 6,000 to 8,000 cu.ft. of 70 to 75 deg. F. air through the work or subdividing room where a number of employees are engaged in breaking down the contents of bulk containers into small volume units desired by our customers. These rooms are cut off from other departments by heavy swinging doors automatically opened and closed through electric-eye control. Their ceilings are cork insulated.

THE air-cooling units are of the direct expansion type in the sense that as the air, sucked by fans through renewable type of filters to remove suspended dirt particles, yeast cells, mold spores and bacteria, passes over coils containing liquid Freon it is cooled to 60 deg. F. by vaporization of the Freon.

In turn the gas is compressed in a battery of three 15-hp. and two 10-hp. motor-driven, single-acting piston type pumps and forced into condenser coils cooled by 15,000 cu.ft. per min. of air drawn from toilet rooms and the general department areas and into which is sprayed water. If water alone were used to liquefy the compressed gas 90 gal. per min. would be needed. By getting rapid evaporation of the water through the use of such a large volume of air only 1 gal. per minute is required. A 42-in. fan is used to draw the moisture-laden air over the condenser coils and to discharge it into an outside vent.

From the direct-expansion cooling coils the filtered air is forced by fans through ducts suspended from the ceilings of the storage and work rooms. The moisture content of the air leaving the fans is so low that when this treated air mixes with the air in the room a relative humidity of approximately 50 per cent is obtained. In the winter, steam-heated coils in the system are used to raise the temperature of the fresh air drawn in so that the room temperatures are maintained at the predetermined level.

To accomplish the desired results each room has its own ventilating system. This arrangement is necessary because the system for the storage room, for economic reasons, is largely recirculating and has to handle nearly twice the volume of air to give from 2 to 5 deg. F. lower temperature than does that for the work room. During the "in-between" seasons, when the outside air is sufficiently cold, the system for the storage room can be operated on a non-circulating basis. That for the work room always operates largely on a non-recirculating basis because of employee comfort reasons.

So well was this ventilating and temperature controlling system engineered into our plant area that no productive floor space is occupied by any part of it. The compressors, condensers, fans, filters and temperature changing units are enclosed on a mezzanine over our laundry. The ducts are all suspended from the ceilings and in no way interfere with production operations.

More than six months' experience with mechanically controlled air temperatures convinces us that we made no mistake in passing up the sites with the wine-cellar type basements for our plant operations.

▶ ***Advantages may be utilized by any company wanting even temperature and low humidity storage conditions such as:***

Bakers
Butter and Cheese Makers
Confectionery Manufacturers
Egg Handlers
Preservers
Small Meat Packers
Wine Makers

Controlled

Cutting Production Costs By Controlled Cooling

Better control of low temperatures plus high velocity air movement increased capacity 20 per cent. Improved refrigeration methods cut power costs $200 per month.

By E. N. HERSHEY
Hershey Creamery Company, Harrisburg, Pa.

INCREASING consumer demand for our packaged ice cream crowded our plant facilities to the point where the inevitable bottle-neck showed up. It proved to be the hardening room where stacks of packaged ice cream were hardened at —20 to —25 deg. F. Roughly, 48 hours at that temperature were required for packages, in the interior of stacks, to become solid.

The plant had been continuously modernized for the 25 years of its existence and, up to a year ago, we believe that anyone would have regarded it as thoroughly up-to-date. It was a smoothly functioning institution until the increase in business volume overloaded the capacity of the hardening room.

Obviously, the solution of the problem of hardening was to increase the rate of hardening. This was accomplished by doing two things: (1) By using a chilled air blast over the goods on a double-decked conveyor in a 10x10-ft. tunnel; (2) by using still lower temperatures for hardening.

In the first step a tremendous increase of air motion was involved. A pair of fans at either end of the insulated hardening tunnel now circulate the air at 1,800 ft. per minute over the packages on a 45-ft. conveyor. The rate of travel of the conveyor can be varied at will, but it averages 1 ft. per minute. This means that a package goes through in 45 minutes and is held only as salable supply in the —10 to —15 deg. F. hardening room, in contrast to the 48 hours at —20 to —25 deg. F. previously required in the hardening room.

However, to accomplish this hardening in so short a time in the tunnel it was necessary to utilize temperatures still lower than those formerly used in the hardening room, despite the very marked advantage of the increased rate of air movement. After consultation with Frick Company engineers it was determined that this rate of hardening required temperatures of —50 to —60 deg. F. Special "flooded ammonia" bunker coils were used to chill the air.

This decision involved another sort of engineering problem, for a temperature of —50 deg. F. requires that the ammonia compressors operate with a very low suction pressure, in fact considerably below atmospheric pressure. If we were to operate the large refrigerating machines, which carried the whole plant load, at such a low suction pressure their efficiency would have been very seriously impaired for to operate a large motor at, roughly,

Perforations in the conveyor permit the blast of cold air to come in direct contact with nearly all surfaces of the ice cream packages.

▶ **Results obtained by the Hershey Creamery Co. are of value to producers of:**

Frozen Bakery Products
Frozen Cream
Frozen Fruits and Vegetables
Ice Cream
Packaged Frozen Fish and Meats

Atmospheres

half-efficiency is a cause of great waste in power costs.

Consequently the refrigerating load was divided up between the old compressor which handled the coolers, freezers and storage rooms, and a new two-cylinder, 8¼x6-in. booster compressor driven by a 10-hp. motor which was to handle the refrigerating load in the hardening room. By keeping all the very low temperature work confined to this small machine the cost of low-compressor efficiency is minimized.

For practical reasons the booster compressor was installed and connected with the hardening room before the tunnel was actually put into operation. In this sense we began to reap some of the benefits of the second step in the revamping of our refrigeration system before we profited by the installation of the new cooling tunnel.

For cooling the tunnel the booster machine is connected to 7,000 ft. of 1½-in. welded pipe to form special "VW" type coils in the bunker space above the quick-hardening tunnel and the booster machine discharges to an intercooler consisting of a shell inside of which is a coil for cooling the liquid ammonia being fed to the evaporators in the tunnel. A bath of liquid ammonia surrounds these coils inside the intercooler and the gas evaporating from this bath emerges together with that coming from the booster machine to cool it to a saturated condition. From the intercooler the ammonia goes to the main suction line leading to the four large enclosed-type compressors which formerly carried the load.

REFRIGERATING machines many years ago reached such a high degree of dependability that the majority of users think of them as operating satisfactorily if they are running smoothly. Cooling systems installed 20 and 25 years ago are still being used with blissful assurance that nothing more is to be desired. As evidence that much progress has been made in the application of refrigerating equipment in recent years, our company through the use of this booster machine with its small motor is now making more ice cream than at any other time in its history and has been able to shut down completely a large refrigerating machine driven by a 187½-hp. motor. Improvements in the condenser and lowering of the head pressure have contributed toward the savings in power effected through the booster system. Electric control valves and float switches make the operation of the booster system almost fully automatic.

After one season's experience with the new set-up it has been found that, by using lower air temperature at a high velocity, the capacity of the entire ice cream plant was increased by 20 per cent through elimination of the bottle neck. And by the improvements in our refrigerating equipment and its operation the power cost was reduced by $200 per month. A new 11½x8-in. booster machine is now being installed to extend the low temperature operations of the plant to meet further production demands.

How Air Conditioning Operates

(From Page 274)

spray cooler is advisable for its purifying effect.

By definition, the use of air conditioning is always accompanied by the use of forced air circulation. The volume of air required and its distribution in the conditioned space is governed by the characteristics of the product to be conditioned, but there are other factors which also influence the method of obtaining the correct air circulating over the product, such as the quantity and arrangement of the product, the size and shape of the room, and the free area for discharge over the product.

IN SELECTING the type of air distribution outlets to be used, consideration must always be given to the fact that there are two streams of air to be brought under control; the primary air which is circulated by the fan and the secondary air circulation which is induced by the outlet velocity of the primary air. The effect of this induction is to set in motion a quantity of air in the room which is much larger than the amount circulated by the fan. The amount of this induction is related to the outlet velocity of the primary air, the size and shape of the openings and their location with respect to walls, ceiling and placement in the room. Generally speaking, low velocity outlets are used for products which require low air velocity and high velocity outlets for application, such as dryers, where relatively high velocities are desirable. There are, of course, variations of this practice depending on conditions encountered.

ANOTHER effect of the secondary air circulation which is very often not well understood, is the diffusion effect. When a room is cooled by forced air circulation, the air delivered from the cooler is several degrees below the room air temperature. At first glance, this might indicate a considerable variation in room air temperature. The air, however, is not delivered directly into the space occupied by the product but usually above it. The low temperature primary air stream mixes with the induced secondary air stream. Since the secondary air stream is at room temperature, the resultant temperature after mixing is only slightly below room temperature. It is evident then that the temperature difference of this mixed air from that of room air is only a fraction of the difference between the primary air and the room air.

IN ORDER to eliminate the human element, the capacity variation which is required under variable load conditions in order to maintain stable conditions, in the room, is made responsive to automatic controls. The two principal controls which are located in the conditioned space are a thermostat and a humidistat. The effect of these controls on the equipment is usually to cause either intermittent operation or to modulate—*i.e.,* to cause gradual changes of all or part of the equipment. Intermittent operation is permissible where the room conditions can vary between reasonably wide limits or where the changes in room conditions take place slowly. Continuous operation with modulating or step control is required where room conditions must be maintained within close limits or where changes occur rapidly when the equipment ceases to operate.

In addition to the primary controls which are directly responsive to room conditions, there are other controls which are required to coordinate the operation of various parts of the equipment, such as gas and liquid flow controls, liquid level controls, etc. These controls are a vital part of air conditioning equipment, because the balanced relationship of the various parts of the equipment is necessary to achieve the "simultaneous control" of the fundamental factors.

Controlled

Adapting Transportation Units to Pre-Cooling

This method of controlling the temperature of a transportation unit, as well as reducing the temperature of its contents, has many possibilities in land transportation. Two outstanding results are achieved by pre-cooling before shipment: (1) Saving 20 per cent of cargo space that would be occupied by machinery and ducts; (2) Prompt cooling below the temperature of fungus growth prevents spoilage.

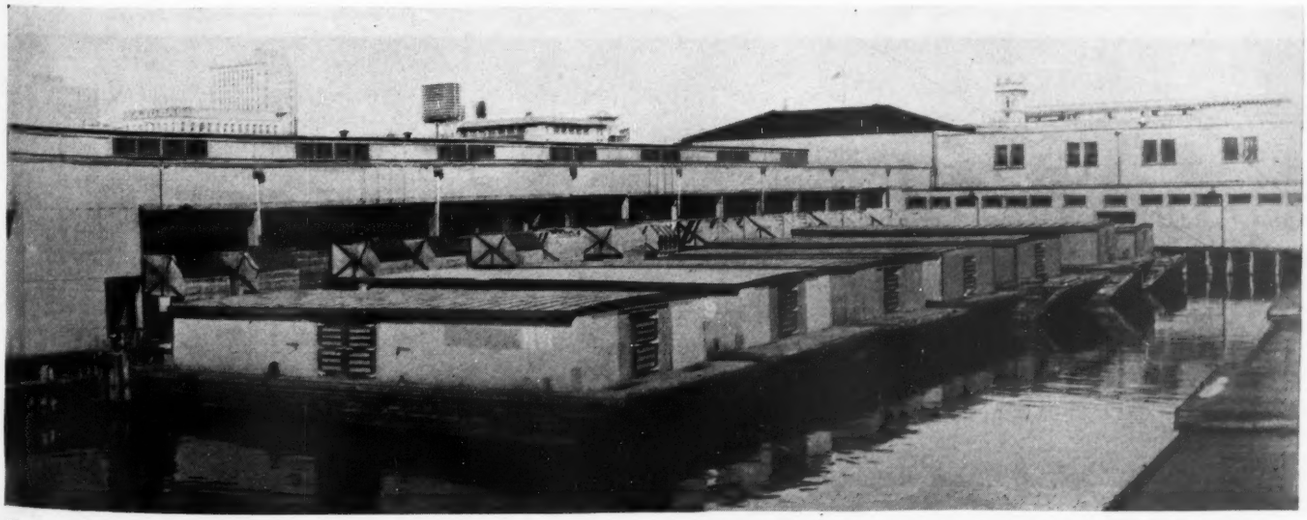
AT JACKSONVILLE, Fla., Clyde-Mallory lines have what is believed to be one of the most modern and complete fruit pre-cooling plants in the United States.

This plant, designed to provide adequate facilities for the pre-cooling at ship-side, of citrus products, fruits and vegetables and to insure their safe transportation to Northern markets, called for the installation of approximately 600 tons of refrigerating and pre-cooling equipment, which was furnished by the York Ice Machinery Corporation.

Twelve floating barges, or lighters, each constituting a separate pre-cooling chamber, were heavily insulated and equipped with floor racks and cold storage doors. Each of these barges has a capacity of 3,000 boxes of oranges or other citrus fruits, thus providing a total cooling capacity of 36,000 standard citrus boxes per 24 hours and affording a flexible means of handling the enormous quantities of perishable fruits and similar products shipped from the port of Jacksonville, which is the principal water shipping point for Florida's important citrus industry.

Pier No. 3 of the Clyde-Mallory Lines terminals in Jacksonville was selected as the location of the pre-cooling plant, and the installation of the heavy compressor equipment on it presented unusual engineering problems which are not discussed here. The four washer rooms, which housed the four large air washing and cooling systems required for a job of this size, were located on the east side of the pier, the west half being left clear for movement of trucks bringing perishable produce for shipment.

A UNIQUE feature of this plant, which greatly facilitates prompt loading of shipments, or the holding of perishable products in safe cold storage for any desired period to await shipment, is the fleet of twelve lighters, or barges. The fact that these lighters are so constructed and equipped that they may be readily converted into special pre-cooling rooms, with provision for the free circulation of cooled air through the boxes of fruit for rapid cooling, adds materially to the facilities and the handling capacity of the plant. The insulated pre-cooling lighters are loaded with cargoes at Pier 3, or at the rail head, and then moved by tug to proper position in the slip east of Pier 3, where the pre-cooling flexible air couplings are attached. Then the pre-cooling air at 29-30 deg. F. is circulated through the cargo and back to the air washers, where it is again cooled and recirculated by four large fans with a capacity of 106,000 cu.ft. each per minute. After this pre-cooling, the lighters are moved to the side of the ship, and the fruit is loaded



Each of these lighters is pre-cooling 3,000 crates of citrus fruit prior to loading the fruit on a refrigerator steamship. Note the pair of ducts extending from farther end of each lighter into the air-cooling equipment on the pier.

Atmospheres

into the refrigerated holds of the ship. The fruit is thus under continuous refrigeration.

The interior construction of these insulated barges is unique in some respects. The insulating material used was a redwood bark fibre, which was shipped in bales. This material was first "shredded" in a special machine, and then fed into the lighters by a compressed air conveyor, through a 6-in. sheet metal pipe, and press-packed into place. The inner sheathing of lumber was then heavily coated with an asphalt emulsion to make it waterproof and air proof. The lighters are provided with two air connections on one end only, but cold storage doors were installed in the ends and sides to permit the loading or unloading of the lighters from either end or side.

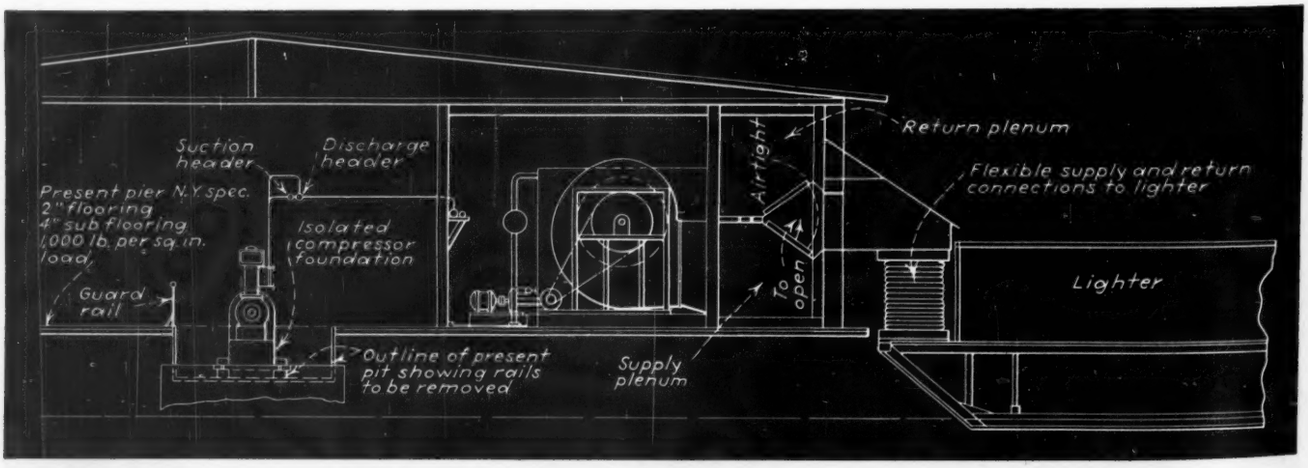
The connections between the air ducts, which were located along the pier at convenient distances to give a minimum length of air travel and low frictional resistance for the air fans, presented a special problem to the engineers, due to the effect of tides and loading, since a lighter does not remain absolutely stationary. Also it shifts its position when the water around it is disturbed by a passing steamer. The air connection therefore required a certain amount of lateral flexibility, as well as vertical movement. This was met by the use of a double thickness of kapok insulating quilting, water-proofed and sewn to tubular aluminum frames, which in turn were sewn in parallel to each other, and the assembly was provided with a fastening frame for attaching to the air hatch, the upper part of the assembly being fastened to the air duct. This provided for the desired two-way flexibility in the air hose couplings.

The means adopted for pre-cooling the air used in cooling the fruit has long been used in Florida for fruit pre-cooling work. Various types of power plants and refrigerating systems installed in the holds of liners and other coastwise fruit carriers had been found to a large extent inadequate for cooling in transit. Yet the amount of heat that must be removed from fruit in order to retard its decay is of tremendous importance from the shipper's standpoint, since a considerable loss in revenue due to decay development, before the fruit becomes cold, is traceable to this cause.

THE experience of refrigerating engineers indicates that in order for fruit to reach the markets in most salable, and therefore most profitable, condition, a reduction in fruit temperature of approximately 40 deg. F. must be accomplished by the pre-cooling process. To accomplish this heat removal as rapidly as possible, or at an average rate of 3⅓ deg. F. per hour when cooling fruit that is wrapped and crated, it is not only necessary to use forced air circulation, but it is necessary to build up sufficient resistance to the air flow, in passing the cooled air through the fruit pre-cooling space, to force the air actually through the boxes or crates and over the fruit itself. This is exactly what is being accomplished by the pre-cooling system installed at the Jacksonville plant. Temperature of the fruit can be reduced from 80 deg. F. to 40 deg. F. in seven to eight hours, although twelve to thirteen hours are usually required except when there is need to hurry.

The question of time consumed in shipment, whether hours or days, often makes an appreciable difference in the prices obtained for fruit. Particularly is this true of the New York metropolitan market, which serves as a distributing point for a vast area. Market conditions in the Northern consuming districts, as well as in other sections of the country, are so variable that it is impossible for the citrus grower to estimate the exact time at which he will be able to obtain the maximum prices for his product when sold at auction in these markets. The long standing necessity for pre-cooling fruit is therefore a well-established need. This uncertainty of price and other factors, such as the law of supply and demand, preclude the use of fruit pre-cooling systems which require long periods of time for cooling, thereby increasing the uncertainty of the price that can be obtained in the metropolitan markets. Also rigid pre-cooling quickly brings the fruit to a temperature where fungus decay is dormant.

THEREFORE, by establishing this up-to-date pre-cooling plant at Jacksonville, which is less than 1,000 miles from New York as a boat sails, and by establishing a regular schedule of full refrigerated sailings between Jacksonville and New York, three times a week, the Clyde-Mallory Lines are able to transport fruit in first-class condition to the New York auction markets.

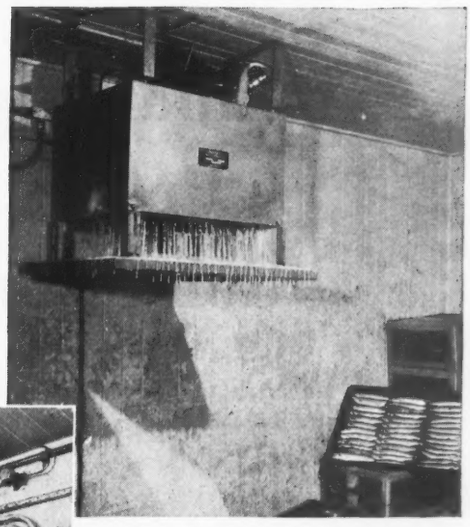

Suction header
Discharge header
Present pier N.Y. spec. 2" flooring 4" sub flooring 1,000 lb. per sq. in. load
Isolated compressor foundation
Guard rail
Outline of present pit showing rails to be removed
Supply plenum
Airtight
To open
Return plenum
Flexible supply and return connections to lighter
Lighter

Cross-section of end of a lighter and one of its air connections, 5 ft.x6 ft. 6 in., showing general arrangement of equipment. Adequate air circulation through goods inside the lighter is obtained by a solid longitudinal partition through the hull. Above the deck it is extended 6 ft. more by a removable canvas. Air flow is reversed hourly by changing the position of the dampers in the plenums (ducts.)

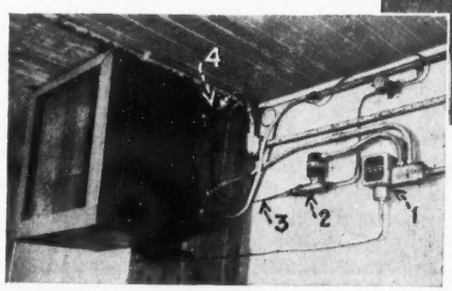
Controlled

Air Cooling Unit Saves $55 per Month

Big economy in unit temperature-control equipment for small plant



View of the "cold diffusing" unit-type air cooler which maintains a temperature of 15 deg. F. and the proper humidity for perfect preservation of sea foods in this storage room of the Golden Gate Fish Co.



Controlled atmosphere in a nutshell—or a space not much larger. Temperature, humidity, and air movement all from this one unit suspended from the wall or ceiling. Added advantage—a number of units operating at varying temperatures may be connected to one compressor by making the thermostat (1) control a solenoid valve (2) in the refrigerant pressure line (3) the liquid refrigerant passes through expansion valve (4) into the unit and back to the condensor (not shown). Compressor control in this case is by variations in refrigerating gas pressure in the cylinders.

SMALL packers or dealers in sea foods generally have had to resort to the rental of freezing and storage facilities. Heretofore the complexity of refrigerating apparatus, the space requirements for compressors and piping and the necessary technical attendance involved prohibitive installation and operating costs for the packer whose storage volume was relatively small. The successful application of a unit cooler to maintain low temperatures and correct humidities in the storage rooms of the Golden Gate Fish Co. therefore, marks an important forward step.

For freezing fish and other seafoods, low temperature (15 deg. F.) is required, so that rapid freezing will take place. Maintenance of this temperature in the frozen storage room is accomplished by means of a small "cold-diffusing" unit suspended from the ceiling.

This unit maintains 15 deg. F. temperature in this room having approximate dimensions of 15x12x8 ft. and cold storage capacity for 12 tons of fish. Humidity control is not important because of the method employed. Fish are placed on trays in the room for several hours. Then each frozen fish is dipped in water and again frozen individually so that its body is encased in a thin ice glaze. The fish are then wrapped in one thickness of paper and stacked in boxes until they are to be marketed.

A conventional ammonia installation would have required a room 30 per cent larger to obtain the equivalent amount of storage space because of the space requirements of the piping system. In addition to conserving space, the unit cooler has the advantage of continually circulating chilled air (60 ft. per minute) so that the entire room is held at an even temperature by the downdraft fan mounted on top of the unit. The only connections to the unit are the small copper tubing carrying the liquid refrigerant under pressure between the unit and the compressor, piping for the humidity control and the electrical connections for the fan.

The second room is used as a cold storage room which is maintained at between 32-34 deg. F. by a similar unit suspended from the wall. This room is used for bringing down the temperature of fresh fish that have been packed in ice for shipment. Here humidity control is most important and the installation is engineered to maintain a relative humidity above 90 per cent. Below this figure, moisture would be removed from the fish itself which would impair its quality. Boxes of fresh fish, iced in the conventional manner for delivery, are placed in this room for 24 to 48 hours during which time the temperature of the fish itself is lowered to that of the ice. It has been found that this procedure results in an appreciable saving in the ice bill.

Units for both rooms operate from the same compressor. The ease of installation, the compactness of the equipment, and the elimination of large piping and air ducts are factors in obtaining economies which enable this type of apparatus to be utilized by the small packer. It is estimated that the cost of operating the installation described above would not exceed $10 per month. Previously rented cold storage space had cost the company as high as $65 a month.

▶ ***How this fish company saves $55 a month and eliminates trucking and labor costs is information also useful to:***

Bakers
Canners
Confectionery Manufacturers
Egg Breakers
Fruit Juice Manufacturers
Fruit Syrup Manufacturers
Egg Noodle Manufacturers
Preservers
Small Meat Packers
True Fruit Flavor Manufacturers
Distributors of Produce and Frozen Foods

Small Operator Profits From Conditioned Air

Controls temperature, humidity and air velocity to improve quality, reduce shrinkage and cut costs.

SMALL plants stand to gain much from properly conditioning the atmosphere under which processing operations are carried out. This has been demonstrated by San Mateo (Calif.) Meat Co., a small packer which stepped the quality of its beef up to a point where it commanded a higher price and invaded new territory in the face of competition from large companies. This packing house also reduced power costs, freed part of its labor from other work in the plant and made a saving in floor space.

San Mateo Meat Co. did all this by replacing an old system of controlling the atmosphere in a beef cooler with a modern one and by adding more storage space in which the air is conditioned to age beef at low cost and with high-quality results.

As formerly operated, the plant employed only one small room, 15 ft. square, for chilling and storing the carcasses, refrigerated by ammonia coils hung on the walls. But when the company decided to increase production and to age its beef longer, additional chilling and storage space was a necessity. So the refrigeration system in the small room was changed and a storage room 30 ft. square and 18 ft. high was built.

The small chill room now is cooled with a unit brine-spray cooler, or conditioner, so compact that it was installed in a shallow recess in one wall approximately 4x8x2 ft. This cooler employs forced air circulation, moving the conditioned atmosphere over the carcasses at a velocity of 100 ft. a minute. This enables the body heat and odor to be removed from the carcasses in 24 hours so that they may be transferred to the storage room. The relative humidity in the chilling room is kept at about 86 per cent, the temperature being 36 deg. F. The air, drawn in at the bottom of the unit cooler by the fan, passes upward through a spray of brine, is delivered through directional vanes across the ceiling, gravitates to the floor and passes back to the cooler inlet to complete the cycle.

After being chilled, the carcasses are moved into the storage room, where the temperature and relative humidity are about the same as in the chilling room, 34-36 deg. F. and 86 per cent, respectively. But the velocity of the circulating air in that room is only 20 to 30 ft. a minute. At this velocity, drying and shrinking of the meat is minimized during the three weeks of aging, yet no moisture condenses on meat or on the walls and ceilings of the room.

This storage room, which will accommodate 100 tons of beef, is provided with conditioned atmosphere by three ammonia-pipe coolers, or cold-diffusers, suspended from the ceiling. Equipped with fans, these units deliver the cold air down over the meat to follow a path across the floor, up along the walls and back to the coolers. One ammonia compressor serves all three of the ceiling coolers. It has a capacity of 3.1 tons and is driven by a 3-hp. motor. A thermostat, located 6 ft. above the floor, controls the room temperature.

In both the chilling and storage rooms, humidity is controlled by regulating the temperature of the refrigerant and the velocity with which the air is circulated through the brine spray or over the ammonia coils.

Among the savings which followed the installation of this modern equipment, an estimated 2½ per cent reduction in shrinkage of the meat is not to be overlooked. Much of this saving comes in the chilling room, where rapid lowering of the temperature at the surface of the meat decreases the rate of evaporation of moisture from the carcasses. It might appear that the circulating air would dry the meat rapidly, but this is not true, because the humidity is high, especially when the carcasses are warm. Warm air rising from the meat is chilled by the cold circulating air to a point where the air next to the carcasses is near saturation. After the beef is chilled, of course, rapid air circulation would be damaging, which explains why it is transferred to the aging room where the air circulates slowly.

Other savings accrue from the small amount of floor space required by the unit conditioners. The compressor for the three units in the storage room requires only 6 sq.ft. of floor space, and the units themselves, being suspended from the ceiling, are out of the way. This system refrigerates approximately six times as much space as the ammonia-pipe system formerly used in the small chilling room, yet that system involved a large compressor, a brine tank and a large cooling tower on the roof, in addition to the ammonia pipes in the roof itself. This old compressor, incidentally, serves the new unit cooler in the chilling room.

The saving effected in power costs comes from the fact that the modern equipment requires about 20 per cent less power than would the equivalent amount of refrigeration if wall-hung ammonia pipes were used.

Since these units are controlled automatically by a thermostat and require little attention, they require a smaller expenditure of man hours, adding to the other savings and to the advantages gained through improvement in quality and higher price.

▶ ***The air conditioning methods which solved the problems of this packer also are applicable to the operations of:***

Bakers
Canners
Preservers
Confectioners
Fisheries
Fruit Products Manufacturers
Egg Breakers
Produce Distributors

Controlled

Temperature and Humidity Control at Three Levels Needed Here

By W. W. REECE

Director of Engineering, The W. E. Long Co., Chicago, Ill.

AIR conditioning in baking plants is, in general practice, confined to definite steps in the process of bread making and to definite departments, rather than to the conditioning of the entire plant. Three specific applications of air conditioning appear in nearly all well-designed and well-equipped plants. They are found in the bread fermentation rooms, bread proof rooms, and bread and cake cooling rooms.

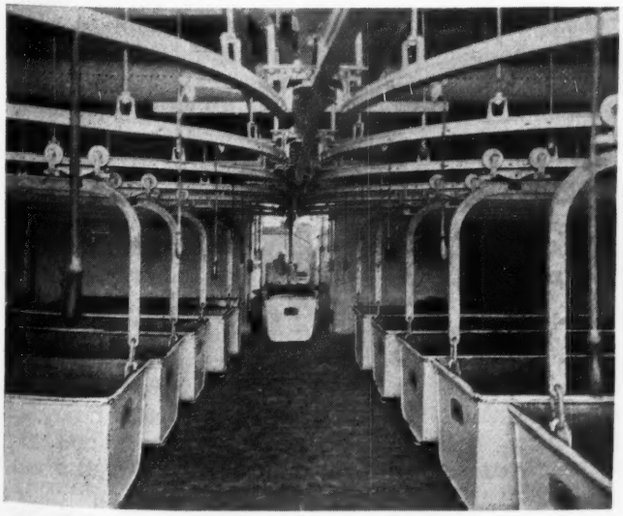
In some localities the variation of temperature and humidity are so extreme, even within a period of 24 hours, that such areas as the flour storage rooms, make-up department, or overhead proofers and packaging department may be conditioned to good advantage. Such precautions prevent chilling of the doughs and also prevent excessive drying out or crusting over of doughs during periods of high temperatures and low humidities. During periods of high temperatures and high humidites flour and other ingredients will absorb moisture and increase their likelihood of becoming musty and moldy. High humidities will also aggravate a sticky condition of the dough and often require an excessive use of dusting flour. In the packaging department the finished product may suffer in quality through excessive loss of moisture on hot dry days because of too long cooling. Where a number of workers are employed the comfort feature is important both from the standpoint of promoting good health and of keeping perspiration to the minimum.

The fermentation room is the first step in the process of converting flour and other ingredients into bread where temperatures and humidities are of critical and vital importance to the baker. Bakery operations, in order to secure uniform quality of product and low cost of operation, should be synchronized and timed so that the bake shop in its entirety will operate on a uniform schedule.

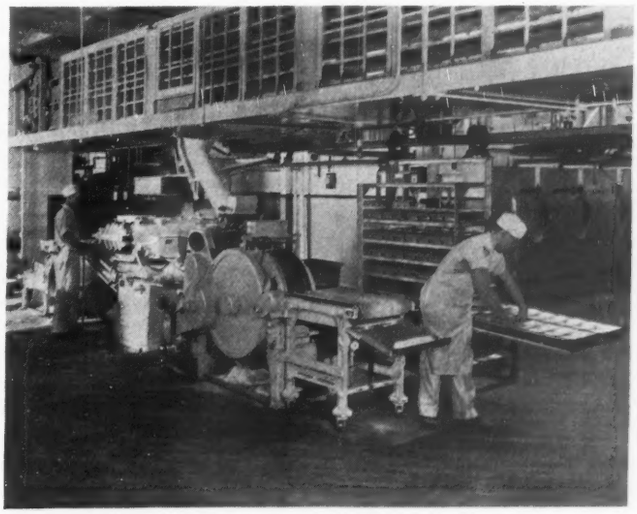
Temperature and humidities, as well as character of ingredients, have

▶ ***Humidity plus temperature control in a minimum of three diverse conditions enable bakers to properly time their operations, maintain uniform quality, cut evaporation losses, prevent spoilage. Comparable results can be obtained in the following industries, even though their processes require only one level of control:***

Biscuit and Cracker Baking
Bread and Cake Baking
Chocolate and Candy Manufacture
Meat Packing
Sugar Refining



Controlled air conditions are obtained in the fermentation room of a southern bakery by discharging humidified air through the perforated duct suspended from the ceiling of the room.



Kern's Bakery, Knoxville, Tenn., uses conditioned air in its molding department and over-head proofer where the dough is exposed to air for a total of 45 to 55 min.

a definite influence upon the fermentation period of sponges and doughs. The character of the ingredients is definitely under the control of the baker through adhering to a formula. But if temperatures and humidities vary the length of the fermentation periods will also vary. If the fermentation room is not under close control, through the medium of a humidifier system, temperatures may vary 20 deg. and relative humidities may vary 20 per cent. This causes uncertainty of quality. The character and flavor of the finished load may vary throughout a shift and from day to day. Lack of control in the fermentation room causes a poor schedule of shop operations with a loss of time on the part of the shop help and results in higher costs of manufacture. It also causes extra supervision on the part of the shop superintendent, which takes his time from other important duties.

If humidities are low, there will be an irregular and varying crusting over of sponges and straight doughs. This crusting causes bad lumps and streaks in the finished loaf which are not good for the loaf from a quality standpoint. There may be an undue loss in weight through excessive evaporation.

Accepted sound practice in the baking industry is to condition fermentation rooms to 78 deg. F. temperature and from 75 to 80 per cent relative humidity with substantially no variation. Purely from an economic standpoint, correct humidities will eliminate excessive and varying weight losses during the fermentation period. This results in an average saving of 0.75 per cent. The investment in a humidifier system is usually amortized in a period of 2½ years with this direct saving.

After the dough is run through the molding machine and panned, it goes into racks which are immediately run into the proofing room so that the dough can go through a secondary fermentation or rising process preliminary to baking.

THE proof room is the second step in the bread making where temperatures and humidities are of critical importance. Sound practice in the baking industry dictates that temperatures of 95 deg. F. and relative humidities of 85 per cent are correct for controlling the proofing. Under these conditions, the molded dough will rise in a uniform length of time and permit of proper adherence to shop schedules. Quality is controlled, as with an even distribution of conditioned air around the dough the proofing or rise is even from the bottom to the top of the rack. Weight losses, while slight at this step in the process, are under control, with a properly chosen degree of humidity.

Bread and cake products leave the ovens at inside temperatures slightly under 210 deg. F. It is desirable that these products reach the customer in as near the finished baked condition as possible. If anything happens between the oven and the home to mar the finished appearance of the product, to cause it to dry out unduly, to injure its texture, or to detract from its goodness, the product, of course, has less appeal to the consumer.

IN uncontrolled open-room cooling, where room temperatures vary from 75 to 100 deg. F. at different seasons of the year, there is a variation of 1½ to four hours in the cooling period. This variation seriously affects both the manufacturing and the delivery schedules. In open-room cooling, there is a varying weight loss ranging from 0.4 to 0.8 oz. per lb. This is a serious economic loss, and further, the product, because of being dried out too much in cooling, stales more quickly. Also, the longer the product is exposed to mold spores present in any uncontrolled room the more danger there is of mold contamination.

Conditioned cooling at temperatures of 75 to 80 deg. F. with relative humidities of 75 to 80 per cent, is coming to be recognized as good standard practice in the baking industry. Under such conditions, the cooling period is stabilized throughout the year, the weight loss is under control, the finished appearance is stabilized and the mold evil is substantially eliminated. From an economic standpoint, the saving of 0.25 oz. per lb. in weight loss pays a direct return of 30 to 40 per cent on the investment in a conditioned cooling system.

It is well to note that these three applications require different temperatures and humidities and for this reason require three different humidifier installations. In practice, it is advisable to condition restricted enclosures in the plant for each of these operations to reduce the first cost of the installations, to insure closer control and to reduce operating expenses.

Other applications which are occasionally made and to which more consideration is being given by bakery owners and baking plant designers are:

1. Make-up Departments. Here the dough is divided, rounded, proofed, molded and placed in baking pans. The dough is in this department for an interval of 35 to 40 minutes. If the natural temperature and humidity condition is unusually severe, air conditioning of this entire department pays. The desirable condition for this department is a temperature of 75 to 80 deg. F. with a relative humidity of approximately 60 per cent. As several employees are in this department, an approximate comfort condition must be maintained.

2. Overhead Proofers. Some attention has been given by manufacturers to the conditioning of the overhead proofers where the dough ball travels back and forth on belts or in trays for a period of ten to fourteen minutes. If the condition of natural air in the plant is extreme, a conditioned proofer is a good thing. A temperature of 80 deg. F. with relative humdiity of 75 per cent is desirable.

3. Finishing and Packaging Departments. Where a diversified line of products is handled, in both bread and cake plants, these departments may well be conditioned to temperatures of 75 to 85 deg. F. with relative humidities of 60 per cent. This condition is especially advisable where a considerable number of employees are employed in such departments.

4. Flour Storage Rooms. In severe climates, these rooms may profitably be conditioned to 80 deg. F. and 65 to 70 per cent relative humidity. This precaution insures uniform ageing of the flour, a minimum loss of evaporation in a dry climate, and the prevention of undue moisture absorption in a humid climate.

In an Arizona plant, which The W. E. Long Company is now designing, the plans call for complete conditioning of the entire plant, with the exception of the oven room and loading room. The material storage room, the bread make-up department and the offices will be conditioned by one conditioning unit to a temperature of 80 deg. F. and a relative humidity of approximately 60 per cent. This is being done because of the severe climatic condition in Arizona where outside temperatures get as high as 115 deg. F. in the summer time.

IT is our opinion that the conditioning of an entire baking plant from a central conditioning system is impractical. Because of the diversified requirements of temperatures and humidities throughout the plant, conditioning should be departmentalized to meet the requirements of the different steps in the processing of bakery products.

Controlled

Control of Odors and Molds by Ozone and Ionized Oxygen

AN investigation into the uses of ozone and ionized oxygen in the realm of controlled atmospheres leads one into a region of some controversy.

Ozone is a well-known substance, very unstable, very oxidative. A very pungent characteristic odor is associated with it. Its chemical formula is O_3 in contrast to ordinary oxygen, O_2. It must be made where it is to be used for it soon decomposes into ordinary oxygen.

Ionized oxygen, also incorrectly called ionized air, is often confused with ozone. Chemists and physicists have long known of ionized oxygen but its industrial use is of such recent origin that opinions differ markedly as to its efficacy. Ionized oxygen is oxygen molecules from which some of the peripheral electrons have been removed.

Both ozone and ionized oxygen occur in nature, but for industrial purposes both can be generated from air by suitable electrical apparatus. Ionized oxygen is absolutely different from ozone and can be generated in a variety of ways such as blowing air at high velocity, spraying water into air (salt water giving positive ions and fresh water giving negative ions), by electrical apparatus and other means. The "stuffy" sensation, or "deadness," of air in closed rooms is believed to be caused by the absence of oxygen ions in the air. A considerable part of the effect of the Sterilamp is believed to be due to ionized oxygen and only partially due to the direct effect of ultraviolet irradiation.

Commercial ozone-producing equipment passes dehumified air through a "brush discharge" of high potential electricity (6,000 volts) passing between two electrodes separated by a dielectric (insulator).

The great oxidizing power of ozone is employed commercially for a variety of purposes. In the field of atmospheric control it is utilized both for deodorizing and for fungicidal purposes, i.e., destroying molds. As a deodorant, ozone is often used in onion, banana and sugar storage, and for "sweetening" cold storage rooms to give them an out-of-door freshness. Many cold storage plants use ozone freely and are fully piped for its distribution to any room or space.

As a fungicide, or destroyer of molds, however, ozone is capable of objective tests where the impressions of the observer are not a factor. And in this service it is decidedly useful in cold storage practice — particularly where high relative humidities are carried, which favor mold growth. One cold storage plant manager has stated that the mold on moldy eggs will actually disappear, as completely as though the mold had evaporated, after about 48 hours in an atmosphere containing five parts per million of O_3. Such a concentration of ozone is abnormally large and is seldom used. Another plant manager says it cannot be done.

"With a continuous concentration of one or two parts per million of ozone, eggs at the end of eight months may be as fresh as when first stored. With particularly well-controlled temperature and humidity, successful storage has been done for even fifteen months, which is well beyond the economical limit." Quoted from Jan., 1936, *Industrial Bulletin,* of Arthur D. Little, Inc.

Ozone has also been used to a small extent in the storage of meat to control mold growth but, while it seems to be beneficial for lean meats, it easily affects the flavor of fat. So active an oxident is ozone that butter exposed to it will turn rancid in 24 hours. Celery turns a bright yellow in ozone.

Ionized oxygen is said to possess oxidative effects which are not so powerful as ozone but this lack is compensated to a degree by its freedom from adverse effects on flavor. Though not so powerful, it is said to be almost as effective a fungicide as ozone.

At the present time commercial tests are under way in which mixtures of ozone and ionized oxygen are used in meat storage rooms. No announcements are available yet. But there is expressed a hope that, by adding ionized oxygen, the amount of ozone can be cut down by 75 per cent, thereby avoiding many flavor changes that are caused by higher concentrations, without losing its mold-destroying power.

FOR cold storage plants ozone offers certain operating problems on account of its corrosive action. The simplest method is to generate the ozone in a centrally located apparatus, and blow it through ducts or piping to the room where it is to be used, by means of a small centrifugal blower. One company has used 3-in. sheet-iron stove pipe for such ducts but they have rusted out with amazing rapidity, necessitating frequent replacements. Another concern has used $\frac{1}{2}$-in. brass pipe to distribute ozonized air throughout an eleven-story warehouse, the ozone being discharged into the outlets of air-circulating blowers. But the pipes have split open, anywhere from an inch to 3 ft. long, after relatively short service, also necessitating replacements. These have been made with iron pipe which, though more easily corroded, is much cheaper.

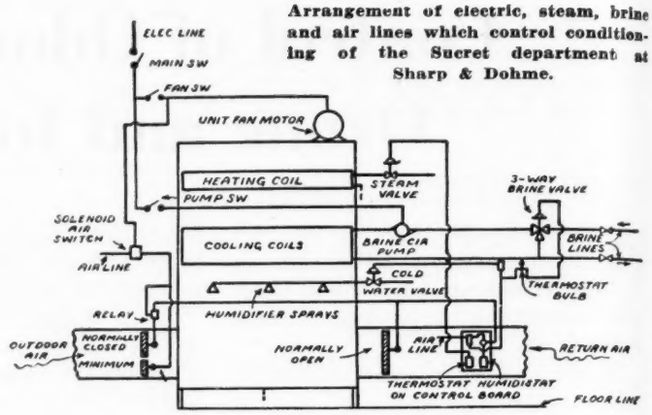
Seamless steel tubing, tile, glass and porcelain tubing have been suggested for this service, but no actual tests of them have been discovered. Many concerns which have experienced the foregoing type of problem of duct corrosion have mounted the ozone equipment on a small truck and moved it from room to room as needed. In contrast to this, however, is the experience of another company which has used $\frac{3}{4}$-in. brass piping for six years without a failure.

For freshening new storage rooms 0.01 part ozone per million of air is used. Other concentrations, such as 0.50 p.p.m. will prevent bacterial and fungus growths in egg and meat rooms. And 5.0 p.p.m. will actually remove fungus growth, according to the experience of a New England company. In a Middle Western cold storage warehouse of 4,000,000 cu.ft. capacity, the ozone machine operates 24 hours a day, consumes 96 kw.-hr. daily, costing about $1.10 at the lowest power rate earned because of the tremendous refrigeration load. The cost of ducts is the major item of cost of ozonizing a large building.

Atmospheres

Humidity Control Solved Problem

By extending use of central low temperature brine refrigeration to medicated cough drop department Sharp & Dohme overcomes stickiness of candies.



Arrangement of electric, steam, brine and air lines which control conditioning of the Sucret department at Sharp & Dohme.

A METHOD of using low temperature brine to obtain air of comfortable temperature and low relative humidity is being used in the medicated throat lozenge—hard candy—department of Sharp & Dohme, Philadelphia, Pa. This department handles 1,200 lb. of candy per hour, having a temperature of 120 deg. when delivered from the cooking department.

These lozenges, like all high-sugar products of the hard candy type, become sticky and give rise to considerable trouble on the forming and packaging machines if handled under comparatively warm temperature and high, or even medium high, relative humidity conditions.

Adding to the problems occasioned by the temperature and natural moisture content of the air is the presence of approximately 50 employees.

► ***Application of low humidity control to eliminate production difficulties is important to manufacturers of:***

Anhydrous dextrose
Breakfast cereals
Candy
Chocolate products
Dry infant foods
Drying starches
Iced bakery goods
Powdered sugar
Powdered malt products
Prepared mixes
Tablet sugars

Also influencing temperature conditions in the department are twelve ½-hp. motors on the automatic lozenge machines and as many as a dozen 150-watt electric lamps.

To get the desired 80 deg. F. dry bulb temperature and 40 per cent relative humidity in the room 40 ft. wide, 60 ft. long and 14 ft. high, 5,000 cu.ft. of air per min. must be circulated. As much as 750 cu.ft. of this air is drawn in fresh from outside the building to maintain comfort conditions for the employees.

The desired temperature and humidity conditions are reached and maintained by a blower-type air conditioning unit into which are built fans, a heating coil, brine cooling coils, and a cold water spray humidifier. The fans are located in the upper part and are belted to a motor on top of the unit. Below the fans is the heating coil and in the bottom of the unit is the humidifier. Between the humidifier and the heating coil are the brine cooling coils.

As all the air is filtered, renewable filters are made part of the system at the points where the air ducts are attached to the humidifier section of the unit.

IN OPERATION, the recirculated air enters the unit under automatic control through the open duct shown at the right in the illustration. These controls consist of an insertion type thermostat and a membrane-element insertion type humidistat. The bulbs of both these instruments extend into the return air stream. The thermostat controls a valve which supplies steam to the heating coils. The humidistat operates a reverse-acting diaphragm valve in the cold water line supplying the spray heads, which are used only in cold winter weather, and also serves as a pilot to another thermostat. The bulb of this second thermostat is inserted in the brine discharge pipe from the cooling coil in the conditioner and in turn controls a three-way brine valve. This 2-in. brine valve permits part of the warmed brine leaving the coil to enter the feed line along with the 15 deg. F. brine supplied from the main-refrigerating system. The resulting mixture has a temperature of 35 deg. F. and does not cause frosting of the cooling coils. A small pump keeps the brine moving through the cooling system. Automatic control over the operation of this pump is obtained by having the wiring of its motor tied in with that to the motor operating the fans.

Wiring to the fan motor is connected to a solenoid air-pressure control switch which is opened by electric current on the line, causing it to admit air pressure for automatically opening a minimum fresh air damper. In this way a definite amount of fresh air is always drawn into the system as long as the fan is running. A relay switch operated by this same air pressure is connected to both the main fresh air damper and the humidistat.

Through this hookup the atmospheric conditions in the room, as determined by the control instruments in the return air duct, govern the amount of fresh air admitted, the amount of air recirculated, the degree of cooling done at the brine coils, the volume of steam turned into the heating coil, and the quantity of cold water sprayed into the humidifier.

Controlled

A quick view of the method whereby the storage life of meats can be doubled by 10 per cent of CO_2 in the atmosphere

Gas Storage of Meats

"Food" (London)

Carbon dioxide supply in cylinders in the rack at left aboard a refrigerator ship in the Australian meat trade.

WITHIN the past two years, striking progress has been made in long time storage of meats in England under what has been termed by Arthur D. Little, Inc., as "Chemically Conditioned Cold." English food technologists refer to it as "Gas Storage."

The method combines temperature control with carbon dioxide control and finds its largest field of usefulness in the transportation of meats from Australia and New Zealand to England. It is also used for storage of fruits, eggs and vegetables. Experience of meat handlers in the United Kingdom shows that with temperature control alone the maximum storage period for beef is 48 days, but with the addition of 10 per cent of CO_2 to the atmosphere this period is extended to 60 or 70 days. The importance of this development is shown by the fact that the minimum transportation period from Australia to English markets is 50 days, whereas the beef formerly could be held for a maximum of only 48 days—a condition which gave South American meat packers a marked advantage because of the shorter route traversed.

Back of this commercial application of CO_2 control of bacterial and mold growth to supplement refrigeration is a very considerable series of researches most of which have been carried out since the World War. One of the earliest discoveries bearing on the subject was that of Kölbe, who announced in 1882 that beef could be stored in an atmosphere of CO_2 up to twenty days without spoilage occurring even though the daytime temperature rose as high as 89 deg. F. (32 deg. C.)

Subsequent investigations, largely conducted in England, have been directed at the following four aspects of the problem. All of it has been of very recent date, mostly since 1930.

1. Effect of cold on micro-organisms
2. Effect of cold on meat
3. Effect of gases on micro-organisms
4. Effect of gases on meat

The latter of these, the effect of gases on meat, is very important, for too much CO_2 will cause the meat to turn black although the gas will at the same time prevent microbial growth. In English practice "chilled" meat refers to meat that has been stored at temperatures between 0 deg.

▶ ***Controlling the chemical composition of the atmosphere by adding CO_2 has been very successful in lengthening the "keepability" of dressed meats. This highly condensed view of a very significant development involves a principle that has wide applications. A thorough knowledge of this subject is information of importance to those who are engaged in the manufacture or handling of the following foods:***

Bacon
Cocoa Powder
Eggs
Fish
Fruits
Meat
Milk, Powdered
Nuts
Vegetables
Other Fat Containing Foods

Atmospheres

C. and —2.5 deg. C. The freezing point of beef muscle in full rigor is about —1 deg. C. "Frozen" beef refers to meat that has been chilled to about —5 deg. C.

A most important factor in the successful application of the new method of gas storage to meats has been the exceptionally rigid sanitary precautions taken all along the route of distribution from the point of slaughter to the point of consumption. These are supplemented by common sense care in preventing bruises, for a bruised spot on the fat-covering of the meat will often bleach out to a white spot, and the fat may become partially oxidized and undergo an appreciable flavor change.

That a slaughter house should approximate the cleanliness of the operating room has been the opinion held at the Low Temperature Research Station at Cambridge, England. The influence of this recommendation has been felt in far off places. An admirable extension of that policy is shown in the care with which Australian beef is protected while being loaded into refrigerator ships, which is a remarkable contrast to the usual careless American methods of handling.

Gas storage is accomplishing much for the English meat trade but equally important is the sanitary care. If infection of carcasses is prevented much less spoilage hazard is involved and, if the meat is entirely free from all microbial infection at the outset and no infections take place enroute, no putrefactive changes can occur. Only such changes will be involved as are brought about by chafing and bruising, which are entirely mechanical; those which are preventable or controlled by humidity, air motion or temperature control; or those of an oxidative character.

"Food" (London)

Gas storage rooms require special construction to make them gas tight. Note the combination of manhole and cold storage door. The manhole opens inward.

Commonwealth and Dominion Line

At Townsville, Australia, the beef quarters are protected from contamination by this "shirt," a covering of clean canvas held on a frame.

Commonwealth and Dominion Line

Beef quarters come overland ¼ mile at Wyndham, Australia, in this special container to protect the meat from microbial contamination.

Twelve ships were equipped for gas storage or were under construction for the Australian trade in 1934. In that year a total of 8,800,000 lb. of beef were successfully shipped from New Zealand and Australia to English ports, thus giving an adequate demonstration of the effectiveness of the method as well as its economic value.

In future issues of FOOD INDUSTRIES will be published a series of reviews of the scientific research underlying the use of CO_2 control or chemically conditioned cold in meat storage.

It is impossible to avoid the conclusion that the use of gas storage in meat transport is but one more step in the series of events that lead to economic nationalism, and that will have a noticeable effect on the future of South American meat packing operations.

Controlled

Makers of Air-Conditioning Equipment

THE FIRMS named on the following list are manufacturers of complete air conditioning systems, unit air conditioners, unit heaters, unit coolers, unit humidifiers, dehumidifiers, air washers, air filters and continuous air cleaning apparatus. Names of manufacturers of other equipment used in air-conditioning work, such as compressors, fans, controlling equipment, etc., have been omitted from this list. The list has been checked to make it as complete as possible at the time of going to press. However, air conditioning is a comparatively new and rapid growing industry, and changes occur so rapidly among those supplying equipment to it, that such a list as follows must inevitably contain some names in error and omit some names that should appear.

Acme Industries, Inc., Jackson, Mich.
Unit Coolers

Aerofin Corp., Newark, N. J.
Unit Heaters, Unit Coolers

Air Devices Corp., 347 Madison Ave., New York, N. Y.
Unit Heaters, Unit Coolers

Airtherm Mfg. Co., St. Louis, Mo.
Continuous Air Cleaners

American Air Filter Co., 215 Central Ave., Louisville, Ky.
Air Filters, Continuous Air Cleaners

American Air Purifier Corp., 208 East 27th St., New York, N. Y.
Air Filters

American Blower Corp., 6000 Russell St., Detroit, Mich.
Central Air Conditioning Systems, Unit Conditioners, Air Washers, Dehumidifiers

American Engineering Co., 2446 Aramingo Ave., Philadelphia, Pa.
Unit Conditioners

American Foundry Equipment Co., Mishawaka, Ind.
Continuous Air Cleaners

American Moistening Co., Providence, R. I.
Unit Humidifiers

Autovent Fan & Blower Co., 1805 North Kostner Ave., Chicago, Ill.
Unit Heaters

W. R. Ames Co., 150 Hooper St., San Francisco, Calif.
Air Filters, Unit Heaters, Unit Coolers, Air Washers, Dehumidifiers

Bahnson Co., Winston-Salem, N. C.
Unit Humidifiers

Baker Ice Machine Co., Inc., Omaha, Neb.
Unit Conditioners, Unit Coolers, Dehumidifiers

Betz Unit Air Cooler Co., 6 West Ninth St., Kansas City, Mo.
Unit Conditioners

Bayley Blower Co., 1938 South Fourth St., Milwaukee, Wis.
Central Air Conditioning Systems, Air Washers, Dehumidifiers

Bishop & Babcock Mfg. Co., 4901 Hamilton Ave., Cleveland, Ohio
Central Air Conditioning Systems, Unit Conditioners, Air Washers, Dehumidifiers

Blaw Knox Co., Farmers Bank Bldg., Pittsburgh, Pa.
Continuous Air Cleaners

Bryant Heater Co., 17825 St. Clair Ave., Cleveland, Ohio
Central Air Conditioning Systems, Dehumidifiers

Burt Air Filter Corp., Grand Central Terminal, New York, N. Y.
Air Filters

Borg-Warner Corp., Norge Div., 670 East Woodbridge St., Detroit, Mich.
Unit Conditioners, Unit Coolers

Builders Iron Foundry, Providence, R. I.
Unit Conditioners

Buffalo Forge Co., Buffalo, N. Y.
Unit Conditioners, Unit Coolers, Air Washers, Dehumidifiers

E. K. Campbell Heating Co., 2441 Charlotte St., Kansas City, Mo.
Unit Heaters

Carraway Engineering Co., Dallas, Tex.
Unit Air Conditioners

Cavco Ventilating Equipment Co., Los Angeles, Calif.
Unit Heaters, Unit Coolers

Carbondale Machine Corp., Harrison, N. J.
Central Air Conditioning Systems, Unit Conditioners, Unit Coolers

Clarage Fan Co., Kalamazoo, Mich.
Unit Air Conditioners, Unit Coolers, Air Washers, Dehumidifiers

Carrier Engineering Corp., 850 Frelinghuysen Ave., Newark, N. J.
Central Air Conditioning Systems, Unit Conditioners, Unit Coolers

Consolidated Air Conditioning Corp., 192 Lexington Ave., New York, N. Y.
Air Filters, for removing odors.

Cooppus Engineering Corp., Worcester, Mass.
Air Filters, Continuous Air Cleaners

Conditionaire Unit Co., 2827 Montrose Ave., Chicago, Ill.
Unit Conditioners, Unit Coolers

Cooling & Air Conditioning Corp., Hyde Park, Boston, Mass.
Central Air Conditioning Systems, Unit Conditioners

Cooling Tower Co., Inc., 15 John St., New York, N. Y.
Air Washers

Corozone Air Conditioning Corp., 1422 Euclid Ave., Cleveland, Ohio
Unit Heaters, Unit Coolers, Dehumidifiers

Copeland Products Co., Mount Clemens, Mich.
Unit Conditioners

Cyclops Iron Works, 837 Folsome St., San Francisco, Calif.
Dehumidifiers

Dail Steel Products Co., Lansing, Mich.
Unit Conditioners, Unit Heaters

Davies Air Filter Co., 390 Fourth Ave., New York, N. Y.
Air Filters

DeFiance Fan Co., Los Angeles, Calif.
Air Washers

De La Vergne Engine Co., Paschall Station, Philadelphia, Pa.
Unit Air Conditioners

Dracco Corp., Harvard Ave., Cleveland, Ohio
Continuous Air Cleaners

Drying Systems, Inc., 1808 Foster Ave., Chicago, Ill.
Unit Conditioners

C. A. Dunham Co., 450 East Ohio St., Chicago, Ill.
Unit Heaters

Economy Equipment Co., Inc., 538 West Pershing Road, Chicago, Ill.
Central Air Conditioning Systems, Unit Conditioners, Unit Coolers, Air Washers

Economy Electric Mfg. Co., Chicago, Ill.
Unit Heaters

Electrogas Furnace & Mfg. Co., San Francisco, Calif.
Central Air Conditioning Systems

Electrovent Fan & Mfg. Co., 1016 West Lake St., Chicago, Ill.
Unit Conditioners, Unit Heaters, Unit Coolers, Air Washers

Electric Air Heater Co., Mishawaka, Ind.
Unit Heaters

Emerson Electric Mfg. Co., 2018 Washington Ave., St. Louis, Mo.
Air Washers

Fairbanks, Morse & Co., 900 South Wabash Ave., Chicago, Ill.
Central Air Conditioning Systems, Unit Conditioners, Unit Coolers

Fedders Mfg. Co., 57 Tonawanda St., Buffalo, N. Y.
Unit Conditioners, Unit Heaters, Unit Coolers

Frick Co., Waynesboro, Pa.
Central Air Conditioning Systems, Unit Conditioners, Unit Coolers

Delco-Frigidaire Conditioning Corp., Dayton, Ohio
Central Air Conditioning Systems, Unit Conditioners, Unit Coolers

FitzGibbon & Crisp, Inc., Trenton, N. J.
Unit Conditioners

General Electric Co., Schenectady, N. Y.
Unit Conditioners

General Refrigeration Sales Co., Beloit, Wis.
Unit Conditioners, Unit Coolers

Grinnell Co., Inc., Providence, R. I.
Unit Air Conditioners, Unit Heaters, Unit Coolers

Goethal Co., Milwaukee, Wis.
Continuous Air Cleaners

Handelan Washed Air Co., 502 East 24th St., Minneapolis, Minn.
Air Washers

Hartzell Propeller Fan Co., Piqua, Ohio
Unit Heaters

Atmospheres

Howe Ice Machine Co., 2827 Montrose Ave., Chicago, Ill.
Unit Conditioners, Unit Coolers
Hugo Mfg. Co., West Duluth, Minn.
Air Filters
Independent Air Filter Co., 215 West Ohio St., Chicago, Ill.
Air Filters, Continuous Air Cleaners
Johnson Fan & Blower Co., 1319 West Lake St., Chicago, Ill.
Unit Heaters
Kaiseraire Products Sales Co., 936 West Chicago Ave., Chicago, Ill.
Air Filters
Kauffman Air Conditioning Corp., 4485 Olive St., St. Louis, Mo.
Unit Conditioners, Unit Coolers, Air Washers
Kelvinator Corp., Detroit, Mich.
Unit Air Conditioners, Unit Coolers
King Ventilating Co., Owatonna, Minn.
Unit Air Conditioners, Unit Coolers, Air Washers
Kleenaire Corp., Stevens Point, Wis.
Air Filters
Kirk & Blum Mfg. Co., Cincinnati, Ohio
Continuous Air Cleaners
Larkin Refrigerating Corp., Atlanta, Ga.
Unit Coolers
Lewis Air Conditioners, Inc., 1600 Northeast Broadway, Minneapolis, Minn.
Unit Conditioners
W. E. Long Co., 155 North Clark St., Chicago, Ill.
Unit Conditioners
McCord Radiator & Mfg. Co., 2588 East Grand Blvd., Detroit, Mich.
Central Air Conditioning Systems, Unit Conditioners, Unit Heaters, Unit Coolers, Dehumidifiers
McQuay, Inc., 1600 Northeast Broadway, Minneapolis, Minn.
Unit Conditioners, Unit Heaters, Unit Coolers
Marley Co., 1737 Walnut St., Kansas City, Mo.
Dehumidifiers
Master Fan Corp., Los Angeles, Calif.
Unit Coolers
Modine Mfg. Co., Racine, Wis.
Unit Air Conditioners, Unit Heaters, Unit Coolers
Murray Iron Works Co., Burlington, Iowa
Unit Heaters, Unit Coolers
Myco Mfg. Co., Detroit, Mich.
Unit Air Conditioners, Unit Heaters, Unit Coolers
L. J. Mueller Furnace Co., 339 South Second St., Milwaukee, Wis.
Air Washers
T. Nugent Sons, Inc., 223 East 80th St., New York, N. Y.
Air Washers, Air Filters
Niagara Blower Co., 6 East 45th St., New York, N. Y.
Unit Conditioners, Unit Coolers, Unit Heaters, Air Washers
National Fan & Blower Corp., Chicago, Ill.
Unit Heaters
Owens-Illinois Glass Co., Newark, Ohio
Air Filters
Peerless Ice Machine Co., 515 West 35th St., Chicago, Ill.
Unit Air Conditioners, Unit Coolers
Payne Furnace & Supply Co., Beverly Hills, Calif.
Unit Heaters, Unit Coolers
Parks-Cramer Co., Fitchburg, Mass.
Unit Conditioners, Unit Humidifiers, Air Washers, Dehumidifiers
Pennsylvania Engineering Co., Philadelphia, Pa.
Unit Conditioners, Dehumidifiers
Peerless Unit Ventilation Co., Inc., Bridgeport, Conn.
Unit Air Conditioners
Perfex Radiator Co., 415 West Oklahoma Place, Milwaukee, Wis.
Unit Heaters, Unit Coolers
W. C. Phillips Co., Inc., San Francisco, Calif.
Unit Conditioners
Prat-Daniel Corp., East Port Chester, Conn.
Continuous Air Cleaners
Pittsburgh Lectrodryer Corp., Pittsburgh, Pa.
Dehumidifiers
Penn Spray Tower Works, Pittsburg, Pa.
Air Washers
Plymouth Cordage Co., North Plymouth, Mass.
Air Filters
Refrigeration Economics Co., Canton, Ohio
Unit Coolers
Reliance Refrigerating Machine Co., 3405 North Kedzie Ave., Chicago, Ill.
Unit Conditioners, Unit Coolers, Air Washers, Dehumidifiers
Research Corp., 405 Lexington Ave., New York, N.Y.
Dehumidifiers, Continuous Air Cleaners
W. R. Ripley Co., Tacoma, Wash.
Air Filters
J. O. Ross Engineering Corp., 350 Madison Ave., New York, N. Y.
Central Air Conditioning Systems, Unit Conditioners
Reynolds Corp., 609 North La Salle St., Chicago, Ill.
Unit Conditioners
Rome-Turney Radiator Co., Rome, N. Y.
Unit Conditioners, Unit Heaters, Unit Coolers
Russell Electric Co., 340 West Huron St., Chicago, Ill.
Unit Conditioners, Unit Heaters, Unit Coolers, Air Filters
Savage Arms Corp., 100 East 42d St., New York, N. Y.
Unit Conditioners, Unit Coolers, Air Washers, Dehumidifiers
Servel, Inc., Evansville, Ind.
Unit Coolers
Scott Ballantyne Co., Omaha, Neb.
Air Washers
R. Semon Bache & Co., 636 Greenwich St., New York, N. Y.
Air Filters
Somers Air Filter Sales Co., Detroit, Mich.
Air Filters
W. W. Sly Mfg. Co., 4701 Train Ave., Cleveland, Ohio
Continuous Air Cleaners
Spray Engineering Co., 109 Central St., Somerville, Mass.
Air Washers
H. J. Somers, Inc., Detroit, Mich.
Unit Conditioners, Dehumidifiers
Staynew Filter Corp., Rochester, N. Y.
Air Filters
B. F. Sturtevant Co., Hyde Park, Boston, Mass.
Central Air Conditioning Systems, Unit Conditioners, Unit Coolers, Air Washers
Surface Combustion Corp., 2375 Dorr St., Toledo, Ohio
Central Air Conditioning Systems, Unit Conditioners, Dehumidifiers
Standard Engineering Works, Pawtucket, R. I.
Unit Humidifiers
Strang Air Conditioning Corp., Kansas City. Mo.
Unit Conditioners
Supreme Heater & Ventilating Corp., 1915 Pine St., St. Louis, Mo.
Air Washers
Trane Co., LaCrosse, Wis.
Unit Coolers
Thermal Units Mfg. Co., 64 East 25th St., Chicago, Ill.
Unit Conditioners, Unit Heaters, Unit Coolers, Dehumidifiers
Trenton Auto Radiator Works, Trenton, N. J.
Unit Heaters, Unit Coolers
C. A. Stilphen Engineering & Mfg. Co., Denver, Colo.
Air Washers.
Thomas Radiator Mfg. Co., San Francisco, Calif.
Unit Heaters
Unit Heater & Cooler Co., Wausau, Wis.
Unit Conditioners, Unit Coolers, Air Washers, Dehumidifiers
Unified Air Conditioner Co., Duluth, Minn.
Unit Conditioners
U. S. Air Conditioning Corp., Minneapolis, Minn.
Unit Coolers, Air Washers, Dehumidifiers
United Blower Co., San Francisco, Calif.
Unit Heaters, Unit Coolers
U. S. Radiator Corp., First National Bank Building, Detroit, Mich.
Unit Heaters
Utility Fan & Mfg. Co., 2528 Santa Fe Ave., Los Angeles, Calif.
Air Washers, Dehumidifiers
E. Van Noorden Co., 100 Magazine St., Boston, Mass.
Air Washers
Vilter Mfg. Co., 2223 South First St., Milwaukee, Wis.
Central Air Conditioning Systems, Unit Conditioners, Unit Coolers
Western Blower Co., 1800 Airport Way, Seattle, Wash.
Air Washers
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
Unit Coolers, Dehumidifiers
Williams Oil-O-Matic Heating Corp., Bloomington, Ill.
Unit Conditioners
L. J. Wing Mfg. Co., 154 West Fourteenth St., New York, N. Y.
Unit Conditioners, Unit Heaters
Wilson & Co., Union Stockyards, Chicago, Ill.
Air Filters
XL Refrigerating Co., Inc., 1834 West 59th St., Chicago, Ill.
Unit Conditioners, Unit Coolers, Dehumidifiers
York Ice Machinery Corp., York, Pa.
Central Air Conditioning Systems, Unit Conditioners, Air Washers, Dehumidifiers
Young Radiator Co., Racine, Wis.
Unit Conditioners, Unit Heaters, Unit Coolers
E. L. Wiegand Co., 7506 Thomas Blvd., Pittsburgh, Pa.
Unit Heaters

The PLANT NOTEBOOK

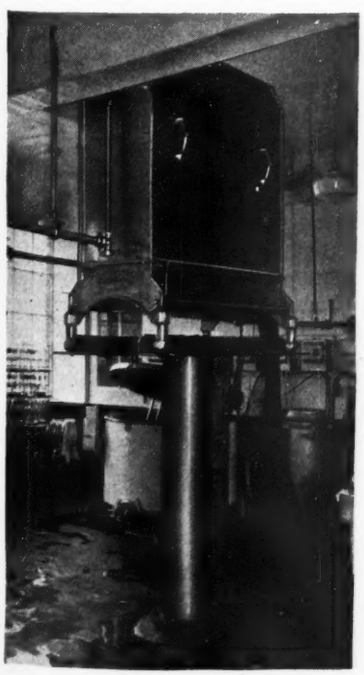
Five dollars will be paid for brief stories which are suitable for use in this department. Sketches or photos should be provided whenever possible.

Hydraulic Lift for Cooler

SERVICE stations and dairies might not be thought to have much in common, but the Smith Sanitary Dairies, Doylestown, Pa., are making use of a device more often used for servicing motor cars—the hydraulic lift.

In this dairy, it is necessary that the milk cooler be elevated some distance above the floor to provide gravity feed into a bottling machine. It it also necessary that the cooler be accessible for cleaning, and for that the floor is the best location. Obviously, both conditions can be met only by elevating the cooler when it is used and lowering it for cleaning.

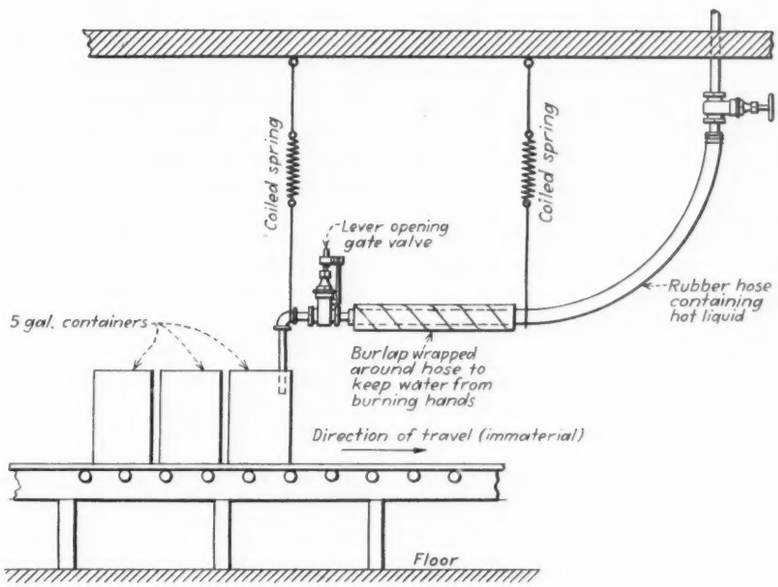
The hydraulic lift shown in the accompanying photograph, installed to meet this necessity, cost $200. It is operated by opening a valve, and uses water at 20 lb. pressure. A second valve releases the pressure and permits the lift to drop slowly to floor level. To prevent mishaps, an iron leg is provided to support the cooler in case the release valve is accidentally opened. To avoid making and breaking six pipe connections every time the cooler is raised and lowered, four pipelines (those carrying brine and water to and from the cooler) are of flexible hose. This leaves only the milk lines to be connected and disconnected.



Hydraulic lift for milk cooler.

Spring Hose Suspension

HERE is a simple device that prevented fatigue of the operator, and also speeded up operations. The problem was to fill 5-gal. containers with a hot liquid, the temperature of which was about 200 deg. F. The volume of business was not sufficient to justify the purchase of an automatic filling machine at the time.



Spring hose suspension.

Obviously the use of a hose with a nozzle and a cut-off valve was the easiest way to fill the containers which moved past the filling point, either on a conveyor or on trucks. Our first plan required the operator to hold the hose and nozzle, dipping the latter into each container and then opening the valve. That gave trouble because the hose soon became too hot for the operator to hold despite his wearing canvas gloves. The next step was to insulate about 5 ft. of the hose with burlap by winding it around and wiring it in place. That kept the operator's hands at a comfortable temperature.

But the hose was heavy, and by the very nature of things it could not be laid down on the floor during resting periods. Therefore it became necessary to relieve the operator about every half hour. So the next stunt tried was that of hanging the hose on ropes extending from the ceiling. The idea was all right in principle, but it was im-

possible to dip the nozzle into the containers if the hose was tied high enough to permit the moving containers to pass underneath the nozzle without hitting it.

Next was tried the set-up shown in the drawing. A 12 in. coiled spring was inserted between the hose and the ceiling, connecting it to both with $\frac{3}{8}$-in. manila rope. Four separate spring suspensions were made at about 4 ft. intervals, so that the hose remained suspended in mid-air at all times whether it was in use or not.

A most important feature, from the standpoint of eliminating fatigue, proved to be the proper adjustment of height of the hose when it was allowed to swing free. The idea ultimately incorporated in the gadget was that the springs should lift the filled hose plus the weight of the operator's hand, clear of the moving containers. Thus he had no load to lift but needed only to press the nozzle gently down and open the valve to perform the filling operation. As soon as the operator released his pressure on the hose, it swung up clearing the containers by about 3 or 4 in.

To avoid mishaps such as wasting the valuable hot liquid, the valve handle was attached in such a way that the moment the operator let it go, the weight of the handle would automatically close the valve. Of course, this necessitated putting the quick-opening valve in such a condition that it would operate freely under these conditions. The gadget was a perfect success and converted the most tiresome job in the plant to one of the easiest. Before this method of spring-suspension was developed, the filling line was the neck of the bottle that usually delayed production.

Springs of this character cost about 50 cents each and are available at nearly any hardware store.

The PLANT NOTEBOOK

You can help yourself and others by using this department for the exchange of useful operating kinks.

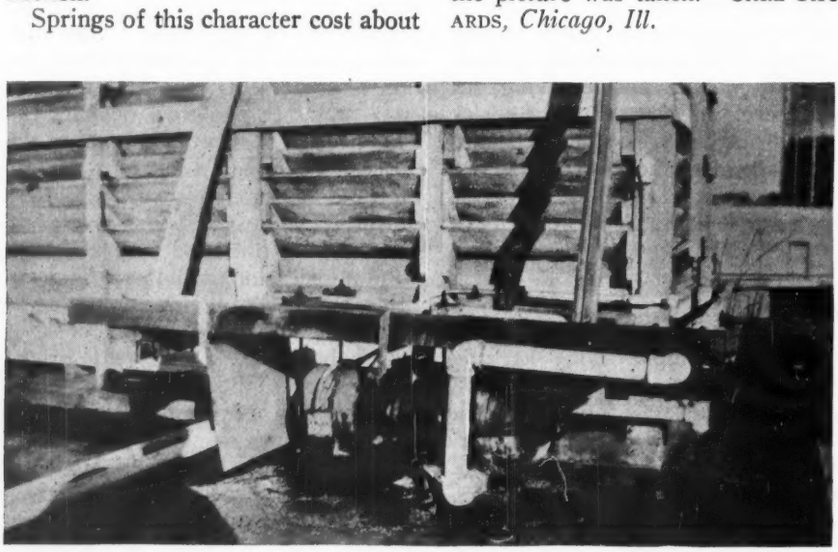
Pumping Unit Suspension

WHEN a cooling tower was installed at our plant it was located on the roof directly over the laboratory. As a result, for about six hours each day, while the pump was in operation, no accurate weighing could be made on the laboratory balance because of the vibration.

This difficulty was overcome through the use of the motor mounting shown in the accompanying photograph. It is composed of two inverted, shelf-type brackets of heavy timber, bolted to the tower studdings. These, in turn, are bolted together with cross timbers directly over the pumping unit.

Four hook bolts suspend the pumping unit clear of the roof. They are cushioned with cork under the washers and nuts on top of the cross-timbers. The piping is also supported from these cross timbers.

In the photograph, only the lower part of the brackets shows. The motor enclosure was removed while the picture was taken.—CARL RICHARDS, *Chicago, Ill.*



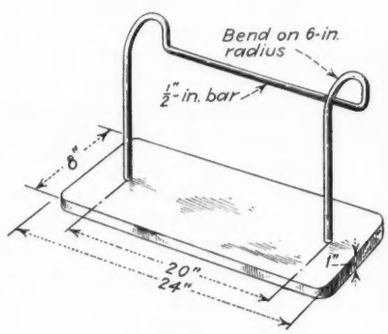
Pumping unit suspension.

Identifying Ready-Mixed Flours

RECENTLY, at a mill in South Australia, a large number of bags of flour containing baking powder ingredients, and not branded, were mixed with bags of plain flour. This caused a great deal of inconvenience. However, identification was established by making a small quantity of the flour into a dough (25 gm. in 15 ml. of water), and putting it into a glass of water. Dough made from the flour containing the baking powder ingredients will float to the surface, while dough made from plain flour remains at the bottom of the glass. This positive and quick test should also be useful to the housewife.—W. J. GAINER, *Port Adelaide, South Australia.*

Repairman's Step

FOR convenience in reaching various places around the plant that require repairs or servicing, and also for reaching the top of truck engines, a handy step can be made from a strong piece of board and a length of small-diameter steel rod.



Handy step.

Cut the board to convenient length, say 24 in. A piece of 1x8-in. oak plank is ideal for the purpose. Round off the edges. On the center line, and 2 in. from each end, bore holes just large enough to accommodate the rod. This rod, which can be of $\frac{3}{8}$ or $\frac{1}{2}$ in. diameter, should be about 5 ft. long. Bend it into U-shape, with the legs of the U spaced the correct distance apart to fit the holes in the board, that is, 20 in. Then bend the lower part of the U into a half-circle on a 6-in. radius, making a double hook. Thread the ends of the bar for 3 in., and fasten the board in place with nuts, top and bottom, and lock washers. The resulting step can be hooked over a bar, guard rail, tire or other convenient place, and provides a secure perch from which to work.

Practical Problems of
TRUCK TRANSPORTATION

DISCUSSED BY EXECUTIVES IN THE FOOD INDUSTRIES

Problems of Operating Semi-Trailers

Question No. 17

1. Are semi-trailers as safe to operate as conventional trucks?

2. On semi-trailer operation, what parts of the vehicle have required the most servicing?

3. What is the value of streamlining semi-trailer bodies, and how far should streamlining be carried?

Several Factors Involved

THE questions are answered as follows:

1. Under good driving conditions, not in mountainous regions, yes. Under abnormal or slippery road conditions, particularly in hilly or mountainous regions, no. The danger lies in the truck "jack-knifing" on a steep grade.

2. Inexperienced drivers are apt to shear off the differential pin of a semi-trailer. Except for this a semi-trailer needs no servicing or repairs not common to all trucks.

3. What might be termed conservative streamlining tends to reduce wind resistance to a certain degree and is advisable. This, in general, consists of rounding sharp corners of the body, particularly the front of the trailer body. This is often built in a perfect semi-circle which both reduces head-wind resistance and facilitates backing and handling the truck in close quarters. Streamlining of any body is of little value until the air speed reaches 50 miles per hour. Further, if streamlining reduces loading capacity to any appreciable extent it may lose its value.—L. J. SCUMAKER, *President, American Cone & Pretzel Co., Philadelphia, Pa.*

Finds Trailers Serviceable

I AM pleased to submit these views in answer to the questions on semi-trailer operation:

1. Our experience would seem to indicate that a given volume of merchandise may be transported with less accidents by means of tractor-semi-trailer units than is possible in any other manner. If one could imagine the substitution of full trucks for tractor semi-trailer operations in metropolitan areas, with the increased number of power units and drivers that would be necessary to haul the same load, there would be no question but that increased traffic congestion would result. Then there would be greater speed on the highways that would increase the number of accidents. As far as safety of operation of tractor-semi-trailer units is concerned, with full air brakes on all wheels of tractor and semi-trailer, we are able to comply with the very rigid requirements of the police department in the City of New York for stopping these vehicles within 22 ft. from a speed of 20 miles per hour.

2. In servicing semi-trailers, we find most repairs are necessary on the bodies, owing to the destructive nature of the ice and water as well as the handling of cases and cans in loading and unloading operations. As to the trailer itself, ordinary preventative maintenance seems to take care of most of our problems.

3. The value of streamlining semi-trailer bodies, in our opinion, would seem to lie more in the nature of a merchandising angle through an appeal to the eye. The air resistance of a unit of this type (or of a truck unit) at the speeds at which we operate equipment is such a small factor, compared with the rolling and gravity resistance, that it is practically negligible.—T. A. DRESCHER, *Manager of Transportation, Borden's Farm Products Co., Inc., New York, N. Y.*

Requirements of Truck Brakes; Methods of Testing

Question No. 18

From a safety standpoint, do you believe that:

1. All trucks, regardless of gross weight, should be capable of stopping in the same distance when traveling at the same speed?

2. If so, what distance should this be when traveling at 20 miles an hour?

3. In testing your truck brakes, how is this distance measured?

4. Can it be measured in any other way than by a deceleration meter?

5. Is it possible to obtain equal stopping distances with service and emergency brakes?

6. If not, do you believe that truck manufacturers should provide emergency brakes at equal capacity to service brakes?

Favors Powerful Emergency

I AM giving you my views on the questions pertaining to brakes for motor trucks:

1. Yes, all trucks, regardless of gross weight, should be capable of stopping in the same distance when traveling at the same rate of speed. The stopping distance of a truck is the most important of its safety factors. Not only do all state laws require this, but to the fleet operator as well as to his drivers it is the assurance of knowing that the vehicle is under proper control and thereby eliminating the question, "My brakes are applied, but where will I stop?"

2. The Ohio State Highway Patrol says that 44 ft. is an efficient stopping distance regardless of load carried or size of truck, when traveling at 20 miles per hour.

3. Two methods are most generally used in testing truck brakes: Deceleration meter; actual road test and measuring tape.

4. Practical road tests in all kinds of road and weather conditions are generally used.

5. It is the writer's opinion that it is not possible to obtain equal stopping distances with service and emergency brakes, owing to variations in loads and so forth. This, of course, applies to present day equipment which has four-wheel service brakes and an emergency which acts only on the two rear wheels.

6. Yes, truck manufacturers should provide emergency brakes at equal capacity to service brakes. An emergency means that it is a pressing need; therefore, it requires that the best possible means for safety be provided.—EDWARD A. SCHENK, *President-General Manager, Columbus Packing Co., Columbus, Ohio.*

Wants "Pleasure-Car" Braking

I WOULD answer the questions concerning the testing of motor-truck brakes as follows:

1. Yes, all trucks should stop in the same distance when moving at the same speed.

2. They should stop in the same distance as the average pleasure car because they use the same highways at the same time.

3. Measured distance on a concrete highway is used in testing brakes.

4. Answered in No. 3.

5. I think it possible to obtain equal stopping distances with service and emergency brakes.

6. I believe it would be advisable for truck manufacturers to provide emergency brakes at equal capacity to service brakes.—A. E. HANSEN, *Libby, McNeill & Libby, Chicago, Ill.*

NEW EQUIPMENT
for Food Manufacturers

Constant Weight Feeder

For continuously feeding and weighing materials at an accurate rate, a new constant weight feeder is announced by the Jeffrey-Traylor Division of Jeffrey Manufacturing Co., Columbus, Ohio.

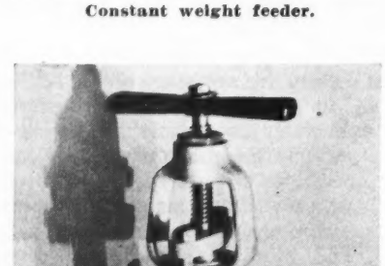
The new design consists of a vibrating feeder controlled electrically by a balanced weighing belt equipped with an adjustable counterpoise for setting the desired rate of discharge. All gates for regulating the flow of material are eliminated and greater weighing accuracy is obtained because of the sensitiveness of the scale. Through an electrical control the vibrating feeder is regulated at all times to satisfy the weighing belt and thus keep operating balance. It is claimed that this unit is accurate to plus or minus 1 per cent or less and can be set to deliver with uniform accuracy at any rate from its minimum to maximum capacity, that is, from 3 to 3,000 lb. per hour.

Constant weight feeder.

Forged Steel Valve

For pressures up to 1,500 lb., the Hancock Valve Division, Consolidated Ashcroft Hancock Co., Bridgeport, Conn., has introduced a new line of forged steel globe valves. These valves are designed with a tongue and groove bolted bonnet and are for high temperature service.

Made in either cone or plug type. the valve, seat ring and disk are of heat treated stainless steel. The makers claim that this trim material is exceptionally hard and therefore resists wire drawing, indenting and galling, and otherwise reduces repairs. The design permits easy repacking in service.



Forged steel valves.

Pipe Insulation

For insulating cold pipe lines, Johns-Manville, 22 East 40th Street, New York, N. Y., has recently announced a new pipe covering known as the Rock Cork Pipe Covering. The material is a specially waterproofed rock wool. It is supplied with a factory-applied waterproof jacket. It provides, in addition to the usual moisture-resistance of the material itself, a waterproof seal against the infiltration of moisture laden air.

Small Plunger Pump

For handling liquids in small quantities and at relatively high pressures, Homestead Valve Manufacturing Co., Coraopolis, Pa., is supplying a small-sized positive displacement pump of the triplex plunger type. The capacity of this pump, depending upon speed, varies from 15 to 120 gal. per hour. Operating at 60 gal. per hour capacity and 200 lb. pressure, a quarter horsepower electric motor is sufficient to activate the pump. In the standard design, the Monel metal inlet valves, corrosion resisting alloy cylinder head and semi-steel crankcase provide protection against corrosion. For special applications the manufacturer will modify the pump to suit conditions.

Trolley Wheel

An improved design of trolley wheel is announced by Osborn Manufacturing Co., 5401 Hamilton Ave., Cleveland, Ohio, for use on Osborn tramrail systems of overhead conveyors. This wheel is made of special analysis, high strength cast iron, with deep-chilled tread and flange, providing a hard, smooth, long-wearing tread surface. Slight crowning of the wheel tread brings the wear on the rail flanges in from the outside. The straight flange of the wheel reduces rolling friction to a minimum. Double-row, shielded type, ball bearings are used.

Streamlined Bottle Washer

For companies that desire to make show-places of their plants, Michael Yundt Co., Waukesha, Wis., has developed a streamlined bottle washer. This machine retains all the features of Yundt washers, with a number of minor improvements added. It is inclosed in a white and chrome streamlined casing, which may be lifted to make operation visible.

Stainless Steel Valves

Valves and fittings, in a variety of stainless steels, are now being made by Alloy Steel Products Co., Inc., Linden, N. J. These are available in gate, globe, wye, glove-angle and cross, and check valve designs, for pressures up to 150 lb. water pressure, and in screw and flanged fittings of standard shapes for the same pressure.

Laboratory Mixer

A more powerful, variable speed laboratory mixer or stirrer, the "Lab-Mix Sr.," has been brought out by Chemical Publishing Co., 175 Fifth Ave., New York, N. Y. It is equipped with a shaded-pole-type motor, uses 110 volt, 50-60 cycle alternating current and is non-sparking. Speed may be varied by rheostat. It has a screw clamp fitting any ring stand, 6 ft. of cord and a plug; and the shaft and propeller are of Monel.

Truck Tires

A new line of tires for half-ton and 1½-ton trucks, known as the "Store-Door Silvertowns," has been developed by B. F. Goodrich Co., Akron, Ohio, for use in city delivery service. Capacities of these tires range from 1,050 to 2,200 lb. Sizes are 6.00x16; 5.25x17; 5.50x17; 5.25x18; 5.50x18; 30x5; 6.50x20; 32x6; 7.00x20; and 7.50x20. They are equipped with treads of an average weight 47 per cent greater than that of a comparable size ordinary tire, the tread design depth and tread width average 30 per cent greater, and the actual rubber contact area with the pavement averages 42 per cent greater.

The Manufacturers Offer

Food Plant Equipment

1. Conveyors — Stephens-Adamson Mfg. Co. Catalog 42 illustrates and gives specifications for conveyors and elevators of the "Redler" type for handling bulk materials like grains and flour.

2. Dairy Equipment — The Creamery Package Mfg. Co. A 44-page catalog entitled "Proof in Pictures," illustrates the use of equipment made by this company in dairy, creamery, ice cream and cheese plants.

3. Dairy Equipment — Standard Milk Machinery Co. A new bulletin describes the various items of equipment included in the Junior Mortensen system of pasteurization, including holder, heater, cooler and surge tanks.

4. Lift Trucks — Barrett-Cravens Co. Bulletin 112 describes and specifies the Barrett "Red Head" lift truck for factory handling purposes.

5. Lift Trucks—Lewis-Shepard Co. Circular 119 shows application of hand lift trucks, skid platforms and floor trucks in the carbonated beverage industry.

6. Mixers — Read Machinery Co., Inc. "New Ones for Old Ones," is a broadside illustrating the Read line of vertical mixers for bakeries and other food plants.

7. Packer's Equipment—The Cincinnati Butchers Supply Corp. A folder illustrates the general line of packer's and butcher's equipment produced by this company.

8. Pumping Equipment — Worthington Pump & Machinery Corp. Five bulletins, as follows: W-317-B5, describing the "Freflo," Type FJ pumps for underpass drainage; W-318-B7, describing balanced multi-stage volute centrifugal pumps, Type UX, for boiler feed service up to 1,000 lb. per sq.in. pressure; W-323-B3A, describing self-priming "Monobloc" centrifugal pumping units; W-320-B2, describing centrifugal fire pumps, Underwriter approved, two-stage volute, of 500 to 1,500 g.p.m. capacity; W-321-B6A, describing "Monobloc" condensate return unit, Types D and G, for building and plant service.

9. Sifters—The J. H. Day Co. Bulletin 363 describes the Day "Ro-Ball" stabilized gyrating screens and sifters.

10. Sifter—The Hinkle Machine Co. A new folder illustrating the design and use of "Sift-All," a multiple sifter for dry ingredients.

11. Soy Bean Equipment — Allis-Chalmers Mfg. Co. Bulletin 1262 entitled "Serving the Soy Bean Processor" gives data on processing soy beans and on equipment for that purpose.

Packaging

12. Bottle Capping Equipment — The Consolidated Packaging Machinery Corp. A new folder illustrates and describes the CaPeM line of automatic capping machines for bottles and screw caps on containers.

13. Bottling Equipment — Pneumatic Scale Corp., Ltd. The "Bottling Work Book," a reference guide giving information on methods, materials and machinery used in bottling works, with emphasis on the products of this concern.

14. Closures — Anchor Cap & Closure Corp. A new folder entitled "Profit For You" discusses the use of the Amerseal caps for closing food products in glass.

15. Stitching Machine—Ideal Stitcher & Mfg. Company. A folder describes the use of the stitching machines made by this company in the production of cartons and other packing containers.

16. Wrapping Machine — Package Machinery Co. A bulletin describing the operation and giving specifications of the Model FA and Model FA-2 carton wrapping machines.

17. Wrapping Machine — Package Machinery Co. A folder discussing the Model AA high speed adjustable wrapping machine for "tight seal" wrapping.

Plant Supplies and Accessories

18. Anti-Friction Bearings—Link-Belt Co. Catalog 1520, a 40-page illustrated catalog of the complete line of Link-Belt anti-friction bearing units available in pillow-blocks, hangers, take-ups and special mountings.

19. Boilers, Electric — Commonwealth Electric & Mfg. Co. A leaflet giving specifications and the prices for "Comm-O-Lectric" electric heating, automatic steam boilers in the range from 3 to 25 b.hp.

20. Diesel Engines—Worthington Pump & Machinery Corp. Bulletin F-500-B29, describes vertical four-cycle direct-injection Type C diesel engines.

21. Electric Fans — Wagner Electric Corp. Bulletin 178 lists and describes various types of industrial and office fans produced by this company.

22. Forged Steel Valves—Consolidated Ashcroft Hancock Co. Bulletin 7000, illustrates and gives specifications for this company's line of forged steel globe valves and globe check valves.

23. Gearing and Speed Reducers—The Ohio Gear Co. A 128-page catalog describes this company's complete line of spur, bevel, worm and other gears, also motorized speed reducers.

24. Insulation — Johns-Manville. New catalog of industrial products covers the subjects of insulation, packing, refractories, roofing and siding, flooring, friction materials, electrical materials, and transite pipe made by this company.

25. Pipe—Bethlehem Steel Co. Folder No. 345 covers the subject of pipe manufacture from the standpoint of quality.

26. Power Generators—General Electric Co. Bulletin GEA-2295, describes turbine-generator sets, in sizes from 10 to 400 kw., for direct current generation.

27. Valves—The Lunkenheimer Co. Circular No. 555, entitled "Guide for selecting valves, boiler mountings and lubricating devices," is a 16-page illustrated list of the various types of this equipment manufactured by this company.

Trucks, Tractors and Accessories

28. Tire Calculator—The B. F. Goodrich Co., Akron, Ohio. As an aid in the selection of tires for 1½-ton trucks, this company has recently issued a special slide rule called "A Truck Tire Calculator," and an accompanying bulletin called, "Practical Guide for Tire Combinations on 1½-Ton and Larger Trucks."

29. Truck Safety — The Four Wheel Drive Auto Co. A 24-page illustrated bulletin discusses the safety advantages of four-wheel drive trucks in industrial haulage.

Control Equipment

30. Thermometers — The Bristol Co. Catalog No. 1250 is an 88-page catalog giving full information concerning this company's line of indicating and recording thermometers and also giving information on the theory and practice of thermometry.

Laboratory Equipment

31. Laboratory Equipment—Laboratory Construction Co. A 40-page bulletin, illustrating and describing various items of laboratory equipment made by this company.

G. L. Montgomery,
Managing Editor, Food Industries,
330 W. 42nd St., New York, N. Y.

June, 1936

TO THE READER: Use this convenient form to get the bulletins you need.

Please send me the bulletins indicated by the following numbers: _____

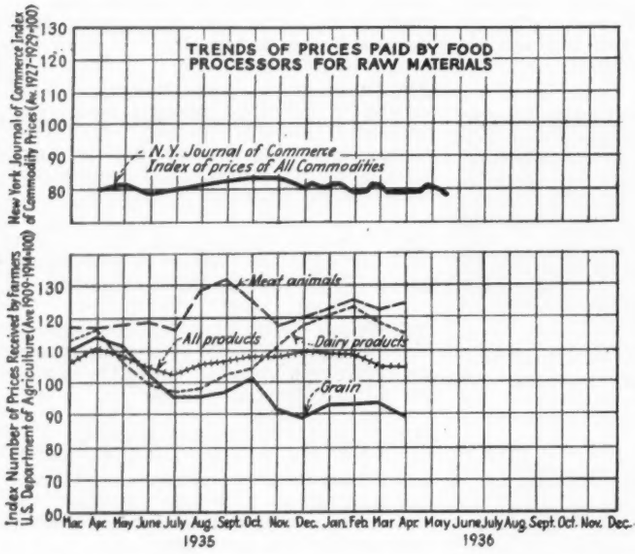
_____

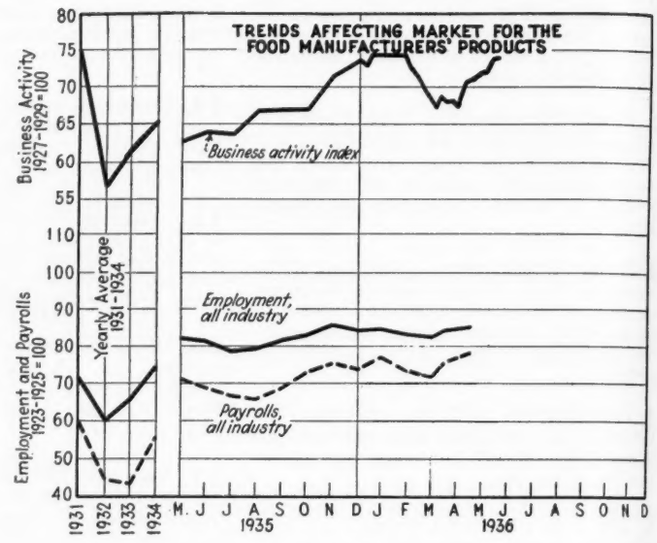
_____

Please Print **Employer** _____ **Your Name** _____

Position _____ **Your Address** _____

BUSINESS TRENDS


TRENDS OF PRICES PAID BY FOOD PROCESSORS FOR RAW MATERIALS
New York Journal of Commerce Index of Commodity Prices (Av. 1927-1929=100)
N.Y. Journal of Commerce Index of prices of All Commodities
Index Number of Prices Received by Farmers U.S. Department of Agriculture (Ave 1909-1914=100)
Meat animals
All products
Dairy products
Grain
Mar Apr May June July Aug Sept Oct Nov Dec Jan Feb Mar Apr May June July Aug Sept Oct Nov Dec
1935
1936



CONTINUING its rebound from the first quarter slump, general business activity registers 74.2 per cent of normal as indicated by the *Business Week* index. This point, for the week ending May 23, is 3.63 per cent improvement over five weeks ago. Car loadings, construction, electric power consumption, and automotive production are the bright lights. Commodity prices, particularly those of agricultural products, continued to fall.

U. S. Department of Labor reports prices for all commodities to be 1.88 per cent lower for the five weeks ending May 23. Those for farm products and food fell 3.10 and 4.44 per cent, respectively, during the same period. The general index of weighted prices compiled by the New York *Journal of Commerce* dropped 2.12 per cent during the month ending May 23. Prices of grain fell 9.36 per cent; food 4.09 per cent in the same period.

No sharp reversals of price or supply appeared among important foodstuffs during the past month. As was expected, the situation as to the supply of meat animals continued to improve, and hog prices on May 19 had reached a level $1.50 below that of April 1, and as low as at any time in May, 1935. The decrease in beef cattle prices was also continued.

Many forecasts of winter wheat yield, made by the government of May 10, and also by private forecasters about the same time, indicated a much lower yield than did earlier estimates. However, with improved weather conditions in the winter wheat growing areas later in the month, fall delivery prices continued to recede.

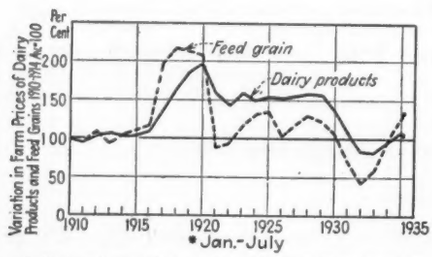
Dairy products prices continued to decline somewhat with the seasonal trend, but low output of butterfat, and below-normal butter make, prevented the decline in butter prices from extending very far.

One outstanding trend that has come to light during the month is the marked increase in the tonnage of soybeans that is being crushed and processed. The first quarter of 1936, at 234,961 tons crushed, showed more than 300 per cent increase over the quantity crushed in the same period of 1935.

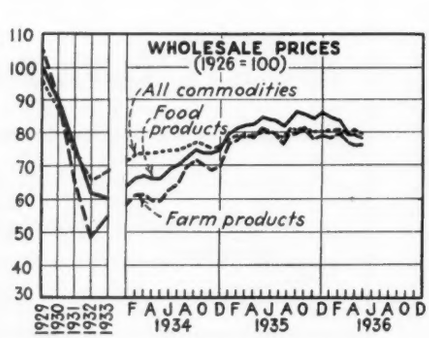
Cocoa bean consumption shows a steady rise. Last year recorded a 22 per cent jump over 1934 in the United States. The first third of 1936 shows about an 8 per cent increase in cocoa bean consumption in the U. S. over the same period of 1935.

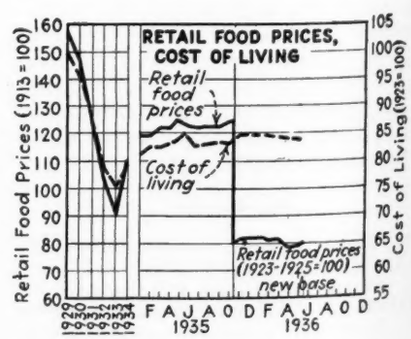
Construction News

	Pending (thousands)	Awarded May (thousands)	Total Awarded 1936 (thousands)
Bakery	....	$40	$859
Beverages	$904	254	2,272
Canning and Preserving	....	....	....
Confectionery	....	....	30
Grain Mill Products	187	300	2,122
Ice Manufactured	....	....	224
Meats and Meat Products	562	197	512
Milk Products	543	37	677
Miscellaneous	28	1,088	1,744
	$2,224	$1,916	$8,440



Indices of farm prices are from the U. S. Department of Agriculture. Employment, payrolls, wholesale prices and retail prices from the U. S. Department of Labor. The business activity index is that of *The Business Week*. The cost of living index is from the National Industrial Conference Board. Data on prices of feed grains and dairy products are from the U. S. Department of Agriculture.





In the Current of Events

- ***Windfall levy, but no processing taxes, in Senate tax plan***
- ***Reciprocal trade treaty with France favors several foods***
- ***Food and drug, price-discrimination measures gain headway***
- ***Bakers get advice on technical and merchandising problems***
- ***New standards established for canned peas, effective Aug. 6***

Senate Plans Windfall Tax

No NEW processing taxes were included in the tax program prepared by the Senate Finance Committee last month, but the committee did conform with the Administration's request for a "windfall" levy on impounded and unpaid processing taxes. The full burden of new permanent revenue of $620,000,000 annually was placed upon corporations and stockholders in the form of a flat 18-per cent corporate income tax, a super tax of 7 per cent on undistributed income of corporations, a capital stock tax of $1.40 a thousand, an excess profits tax and a 4-per cent levy on corporate dividends in the hands of stockholders.

The committee also approved an import tax of 4½ cents a pound on vegetable fats and oils.

Food Bill Moves Along

AFTER a delay lasting since the convention of Congress, the House Interstate and Foreign Commerce Committee favorably reported a modified Copeland food and drug bill on May 20. But there still remains much doubt as to likelihood of enactment before adjournment. If the House passes the bill as reported, there will be difficulty in reconciling it with that passed by the Senate last year. Among the differences between it and the Senate measure is that control of advertising is under the Federal Trade Commission instead of the Food and Drug Administration.

French Treaty Favors Foods

APPRECIABLE benefits accrue to exporters of food to France through increased quotas, stabilized tariffs and reduced duties provided in the Franco-American trade agreement signed May 6. Among the foods for which French tariffs were directly reduced are grapefruit (with a 50 per cent cut), unsweetened canned pineapple, dried prunes, raisins and canned asparagus. Those favored by being bound against a duty increase include dried peaches, apricots, apples, pears and frozen salmon.

Lower duties obtain as a result of "most-favored-nation" treatment for whole (milled) rice, canned salmon and crustacea (lobsters, shrimp and crabmeat). Canned sardines are granted lower rates for specified quantities.

Foods to be admitted to France in larger quantities include canned salmon and fresh apples and pears.

No important concessions were made to France as far as foods are concerned, except for a 50 per cent reduction in duties on sparkling wines and substantial reductions for light wines (in bottles but not in bulk). Tariffs also were cut with respect to Roquefort cheese, canned mushrooms, maraschino cherries and vanilla beans.

CARL F. STROEHMANN
Elected president of Quality Bakers of America

Price Bills Gain Support

PASSAGE by the Senate of the Robinson price-discrimination bill, festooned with amendments including the entire Borah-Van Nuys bill on the same subject, has greatly increased the chance of enacting some legislation of this type before adjournment of Congress.

In the House, the pending proposal is the so-called Patman bill, as completely revised by a subcommittee after extensive hearings. This differs materially from the Senate form. The Patman bill has been reported favorably and will probably come up for action following the pending relief-appropriation bill. Assuming that the House approves, as seems probable, the final law will be written by a conference committee of the two houses subject, of course, to their final approval.

Bakers Get Pointers

BAKERS should pay special attention to the development of marketing facts, creative sales plans and intelligent advertising, building not for the day or the week, but for years ahead. This is what W. S. Allison, general manager, told members of Quality Bakers of America at their general conference in New York recently. The good will and the business created by the right kind of planned advertising will be one of the great resources of strength in the years ahead, he said.

Speaking on a technical phase of baking, Dr. Oscar Skovholt told the bakers that "a real testing of flour suitability involves baking tests with varying mixing treatments, different fermentation times and different formulas." Formerly professor of bio-chemistry at University of Minnesota, Dr. Skovholt will supervise a chemical research laboratory which the Association will add to its central service quarters. The

Conventions

JUNE

1-2—Flavoring Extract Manufacturers' Association, Hotel Pennsylvania, New York.
1-3—National Association of Manufacturers of Fruit and Flavoring Syrups, Pennsylvania Hotel, New York.
1-5—Association of Operative Millers, Baker Hotel, Dallas, Texas.
2-5—American Association of Cereal Chemists, Adolphus Hotel, Dallas, Texas.
8-12—National Confectioners' Association. Waldorf-Astoria Hotel, New York.
15-16—National Macaroni Manufacturers' Association, Edgewater Beach Hotel, Chicago.
15-17—Biscuit and Cracker Manufacturers' Association of America, White Sulphur Springs, W. Va.

laboratory will examine the ingredients of breads and test the finished product as to appearance, crust, texture, flavor and aroma.

Another Sugar Bill

ALTHOUGH four substitute bills for the Jones-Costigan sugar act were introduced in Congress in April, the sugar section of AAA has prepared another. This was on the point of being introduced by the House committee on agriculture when the Supreme Court invalidated the Guffey coal act and gave rise to new questions which had to be taken into consideration before the bill could be put before the House.

The Administration's bill is similar to that introduced by Senator Harrison at the request of Senator Costigan, author of the original act. It provides benefit payments of 37½ cents a hundred pounds of sugar, ties the sugar program in with the soil conservation plan and establishes quotas for all producing areas.

New Fruit Process

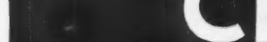
CHEMISTS of the Department of Agriculture are reported elated over the success of experiments with new methods of concentrating and preserving fruit and fruit juices. Best results have been obtained with apples, the juice of which is treated with a pectose enzyme preparation prior to filtration. The juice is then concentrated, after filtering, by evaporation under a vacuum, the distillate being condensed and the first part returned to the concentrate because it contains flavor.

Revises Pea Standards

STANDARDS for canned peas have been revised by the Food & Drug Administration, effective Aug. 6. The water-insoluble-solids determination has been replaced by a determination of the percentage of alcohol-insoluble solids of the drained peas. The percentage of peas ruptured 1/16 in. or more is retained as an index of maturity, and in addition, a determination of the percentage by weight of peas which sink in a brine of 1.12 specific gravity has been added.

No change is made in the standard of quality or condition of fill of container.

Improve CLEANING and STERILIZING efficiency with modern OAKITE materials and methods



Bacteria, mold spores and other organisms multiply and grow faster on equipment during the hot Summer months!

So why not give yourself a wider margin of SAFETY and PROTECTION against bacteria and organisms that may affect the quality of your product by using dependable, efficient Oakite cleaning and sterilizing materials.

Leading concerns in the food industry rely on Oakite materials because they provide a high degree of sanitation, day in and day out . . . do it quickly and at low cost!

Write today for interesting booklets mailed free on request, without obligation on your part and find out the many advantages you can secure as a result of our 27 years' experience helping concerns like yours.

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OAKITE

TRADE MARK REG U.S. PAT OFF.

SPECIALIZED INDUSTRIAL CLEANING MATERIALS & METHODS

Concentrates

▶ THE Connally-Murphy bill imposing new regulations on meat packers has reached the files of the House Committee on Agriculture, where it is likely to remain indefinitely. . . . A reciprocal trade agreement affecting lard, apples, pears, plums, grapefruit, raisins, preserves and cheese is being negotiated with Finland. . . . The Food & Drug Administration recently prosecuted three Chesapeake Bay crabmeat packers whose careless plant practices resulted in germ-laden products.

▶ SIX CREAMERIES have been penalized through action of F&DA for weight shortages, low butterfat content, and mold and barnyard dirt in butter. . . . Shortages in fruit content and adulteration have resulted in a number of additional seizures in the F&DA campaign against substandard preserves. . . . Confectionery manufacturers distributed 59.6 per cent of their products through wholesale distributors last year, compared with 58.6 per cent in 1934, 56.7 in 1933 and 53.7 in 1932.

▶ WEST TENNESSEE is increasing in importance as a source of supply for cold-pack strawberries, with plans for packing 2,250 bbl. this season. . . . Northwestern Turkey Growers' Association is experimenting with the canning of turkey meat.

▶ TAXES on chain stores, soft drinks, candies, chewing gum and ice cream have been approved by the Kentucky general assembly.

Men . . . Jobs . . . and Companies

Industry

• ARMOUR & Co. has opened another branch at San Francisco.

• CARNATION Co. is constructing a milk cooling plant at Okolona, Miss., from which milk will be shipped by tank truck to its Tupelo condensery.

• GENERAL FOODS CORP., New York, is marketing a new coffee, "Showboat," in some sections of the South. Sold on an experimental basis, the coffee is packed in paper bags enclosed in transparent cellulose.

• HELWIG & LEITCH CORP. has acquired Tidewater Pickle Co., West Point, Va., and will make major improvements. V. M. Barlow continues as manager.

• H. P. HOOD & SONS, INC., recently took over the Marioni Ice Cream Co., New Haven, Conn. The personnel will not be altered.

• IGLEHEART BROS., INC., has leased Collins Flour Mill, Pendleton, Ore., to provide for an increased demand for cake flour in the West.

• KRAFT-PHENIX CHEESE CORP. is now operating a plant at McEwen, Tenn. Built to handle 30,000 lb. of milk daily, this is the third Kraft plant in Tennessee.

• LIBBY, MCNEILL & LIBBY is erecting a new warehouse and office building at Memphis, Tenn.

• PET MILK Co. has taken over, with a two-year option to buy, the plant of Beech Milk Products Co., Philadelphia, Miss. The plant will be used as a receiving station.

• PHILLIPS PACKING Co. has purchased its fifteenth factory, located at Laurel, Del. Originally owned by Valliant Co., the plant will be modernized to pack tomatoes, beans, spinach, beets and other vegetables.

• RAMSDELL PACKING Co., Rockland, Me., plans to manufacture cat food from sardine scraps.

• STANDARD BRANDS, INC., is constructing in Kansas City, Mo., a new coffee roasting plant to have a capacity of 1,000,000 lb. a month.

• SUNNY BROOK DAIRY will establish a pasteurizing plant and creamery at Florence, Ala., to be opened about June 1.

• SWIFT & Co. is erecting an ice cream plant at Knoxville, Tenn.

• TEXAS VINEGAR Co. is building at Fort Worth a plant with a capacity of 1,250,000 gal. annually.

Personnel

• A. J. BATES, JR., has been named general manager of G. Heileman Brewing Co., La Crosse, Wis.

• HAROLD L. BUMBALEK succeeds William E. Lovell, resigned, as manager of Meier Ice Cream Co., Milwaukee.

Advertisement published in 1922

HOW THE RIVITZ COMPANY CUT HAULING COSTS 75%

TODAY

THOUSANDS REPORT TREMENDOUS SAVINGS

Fourteen years ago, a statement like that made by the Rivitz Company was vitally important news to industry.

Today it is just as important —but reports of such huge savings are common because the use of Yale (Stuebing Cowan) Trucks has been vastly multiplied throughout the industrial world.

WHY? Because this modern equipment DOES save many thousands of dollars for users by their speed, efficiency, safety and amazing durability in lifting and hauling all types of materials.

The evidence is overwhelming. It is FACT, not theory; ACTUAL EXPERIENCE, not mere conjecture. In every field of industry, stories of Yale performance are everyday news.

Yale Trucks can save YOU money. We are ready to prove this to you beyond question by the experience of your own industrial neighbors.

5c a Month Upkeep for 51 Trucks

That is the maintenance cost reported by one user over a 2-year period. Yale Trucks stand the gaff! Year in, year out, they handle capacity loads without flinching. Steel constructed, precision built, exclusive features provide easy roll, easy lift, years of constant service.

-YALE-

Write today to

THE YALE & TOWNE MFG. CO.
PHILADELPHIA DIVISION
PHILADELPHIA PA., U. S. A.

• George C. Emrich recently was made vice-president of Franklin Brewing Co., Columbus, Ohio.

• Frank A. Godchaux, Jr., has succeeded his father as president of Louisiana State Rice Milling Co., Abbeville, La. The elder Mr. Godchaux now is chairman of the executive committee.

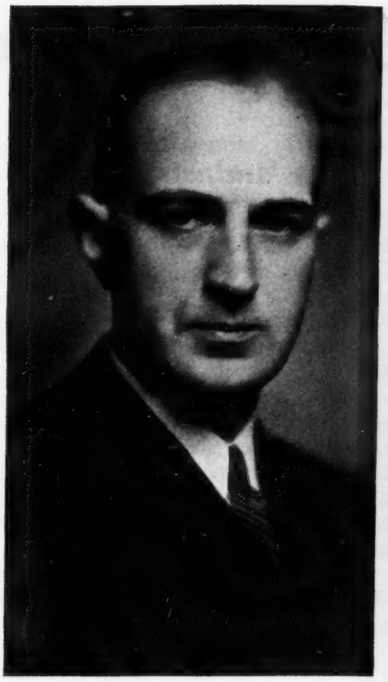
• Andrew M. Gray, Maryland Biscuit Co., Baltimore, heads up the Technical Institute of Independent Biscuit Manufacturers.

• Dr. J. T. Jardine recently was appointed director of research for the Department of Agriculture.

• Dr. G. C. North, formerly with Wisconsin Alumni Research Foundation, has become affiliated with Beatrice Creamery Co., Chicago.

• Lawrence Ortman, Ortman Bakeries, Omaha, recently was named president of Nebraska Master Bakers' Association.

• Dr. Sutton Redfern, Johns Hopkins University, went with Fleischmann Laboratories, New York, on June 1, to do research on enzymes.



ARTHUR C. SCHIER

He succeeds E. C. Nettels, retired, as general traffic manager of General Foods Corp., New York. He has been active in traffic work for nineteen years.

• Oscar A. Spiegelhalder has resigned from the administrative staff of St. Johns University, Brooklyn, N. Y., to become connected with Beech-Nut Packing Co. as experimental baker and chemist.

• John R. Strohecker now is executive vice-president of Runkel Bros., Inc., New York. He had been assistant general sales manager of Bauer & Black, Chicago.

• Leonard W. Styve, for five years assistant manager of the Norfolk branch of Standard Brands, Inc., recently became manager of that branch. He succeeds Joseph J. Karl, now with Hobbs Bakery, Inc., Norfolk.

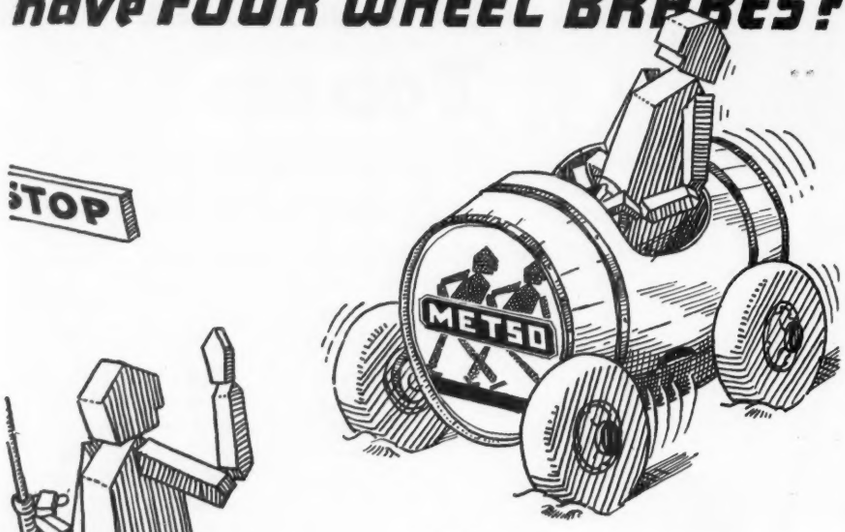
• Phillip K. Wrigley, president of Wm. Wrigley, Jr., Co., Chicago, is now a director of Gunnison (Utah) Sugar Co.

Deaths

• Albert Bunte, 81, a founder of Bunte Bros., Chicago, May 4. He had retired in 1929.

• C. N. Cosgrove, chairman of the board of Minnesota Valley Canning Co., Le Sueur, recently.

DOES YOUR CLEANER have FOUR WHEEL BRAKES?



OR DOES IT go right on etching and spangling metal surfaces without restraint? Controlled cleaning is possible only with a controlled cleaner—METSO.

Leading food manufacturers rely on Metso for a two-fold purpose:

1. **Vigorous alkali activity to remove all dirt, fats, oils quickly, completely**
2. **Silica monitor action to curb corrosive effect on sensitive metal surfaces**

Clean all your equipment, utensils and containers faster and thoroughly with Metso and keep them shining and lustrous. You pay no more for the extra safety margin in Metso.

Try a sample yourself, or let our field man demonstrate Metso's safety to you.

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General Offices and Laboratory: 125 S. Third St., Phila., Pa. Chicago Sales Office: Engineering Bldg. Distributors in 60 cities. Sold in Canada by National Silicates Ltd., Toronto. U. S. Pat. 1898707

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METSO

METSO CLEANERS

GEORGE M. ARMOR

American Spice Trade Association re-elected him president at the annual convention last month. He is with McCormick & Co., Inc., Baltimore.

• J. W. HAYES, 83, president of Jersey Ice Cream Co., Minneapolis, Minn., recently.

• H. R. ISALY, 66, a vice-president and director of Isaly Dairy Co., Youngstown, Ohio, April 27.

• WILLIAM KELLY, 77, president of William Kelly Milling Co., Hutchinson, Kan., April 28. He had been active as a miller for more than 60 years.

• SAMUEL R. KENNEDY, 89, for 50 years president of Kennedy Creamery Co., Philadelphia, May 4.

• BENJAMIN LEWIS, president of Lewis Packing Co., Omaha, recently.

• DR. CHARLES E. MANGELS, former president of American Association of Cereal Chemists, recently. He was with the North Dakota Agricultural Experiment Station.

• CHRISTIAN SCHWARTZ, president emeritus of Quality Master Bakers of America and retired vice-president of Bixler Baking Co., Youngstown, Ohio, May 10.

• CHARLES H. STEUBER, 50, superintendent of Kurth Malting Co., Milwaukee, April 26.

• EDWARD L. WEMPLE, 70, for many years vice-president and general manager of Warner Sugar Refining Co. and for the past six years with Lamborn & Co., New York, May 12.

Associated Industries

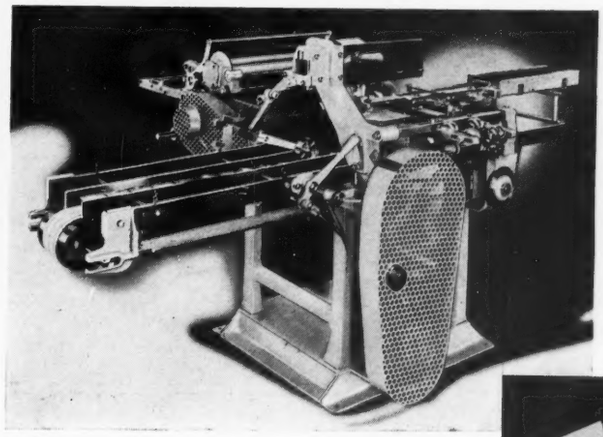
• AMERICAN CAN CO., New York, announces the election of W. H. Phelps, formerly president, to chairman of the board. C. E. Green, vice-president and comptroller, becomes president.

• BRISTOL CO. has appointed L. E. Mustard district manager at Detroit.

• LINCOLN ELECTRIC CO. announces these changes in its sales personnel: J. S. McKeighan is stationed in Dayton, Ohio; J. B. McCormick, in Fresno; Paul W. James, in Binghamton, N. Y.

• REPUBLIC STEEL CORP. has appointed Jensen-Byrd Co., Spokane, distributor of Enduro stainless steel, and Cameron & Barkley Co., Jacksonville and Miami, distributor of tubular products.

• THADDEUS G. SEARLE, 52, general sales manager of Continental Can Co., New York, died May 18.



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FA
ADJUSTABLE
WRAPPING
MACHINE

Winning New Users rapidly!

The model FA, a recent addition to our line, is one of the most popular wrapping machines we have ever introduced—and that's saying a lot! Here's why:

Moderate Price—Offers advantages formerly obtainable only in machines selling at much higher price.

Adjustable for a wide range of package sizes.

Versatile—Can be adapted to practically any type of wrapping material.

Simple in construction—easily adjusted.

Fast— 60 to 75 per minute.

Smooth in action—no hard, jerky motions.

Saves floor space—Occupies only 6'6"x5'.

If you have to replace obsolete wrapping machines, you certainly should consider the FA. If you are wrapping packages by hand, the FA will show large savings, even if operated only part time.

Write for complete information.

PACKAGE MACHINERY COMPANY
SPRINGFIELD, MASSACHUSETTS

New York Chicago Cleveland Los Angeles Mexico: D. F. Apartado 2303. Peterborough, England: Baker Perkins, Ltd. Melbourne, Australia: Baker Perkins, Pty., Ltd.

PACKAGE MACHINERY COMPANY
Over 200 Million Packages per day are wrapped on our Machines

PATENTS

Cereal Products Cooked and Extruded in Plastic Form Through an Extrusion Cylinder Under Piston Pressure—Frank D. Campbell, Cedar Rapids, Ia., to Quaker Oats Co., Chicago, Ill. No. 2,036,681. April 7, 1936.

Sugar Recovered From Limed Solution by Disintegrator Action—Sherman Chase Meredith, San Mateo, Paul Warren Alston, Berkeley, and Edward Taber Winslow, Saratoga, Calif., to Spreckles Sugar Co., San Francisco, Calif. No. 2,036,818. April 7, 1936.

Cellular Foods Reduced to Less Than Normal Cell-Size Particles Preliminary to Drying Over Heated Surface—William W. Cowgill, Fairfield, Conn., to Sardik, Inc., Jersey City, N. J. No. 2,037,009. April 14, 1936.

Starch-Containing Cellulose Food Cooked to Form a Softened Mass in Which the Cellulose Particles are Reduced to Substantially the Same Size as Particles of Extra-Cellular and Sub-Divided Starch—John T. Knowles, to Libby, McNeill & Libby, Chicago, Ill. No. 2,037,029. April 14, 1936.

Crushed Roasted Coffee Freed of Air by Vacuum and Subjected to Carbon Dioxide Gas Pressure Prior to Airtight Packaging—David Pelton Moore, Avon Park, Fla., to Max A. Schlesinger, New York, N. Y. No. 2,037,037. April 14, 1936.

Noodle-Like Product Made From Gluten-Free Starch and Egg Yolk — Rose G. Perewe, Brooklyn, N. Y. No. 2,037,042. April 14, 1936.

Fresh Flavor-Imparting Ingredients Solidified by Freezing and Reduced to Small-Sized Pieces for Distributing in Solid Form Throughout Food Mixture — Charles H. Vogt, to Modern Food Process Co., Philadelphia, Pa. No. 2,037,355. April 14, 1936.

Sliced Bread Loaf Inserted Into Protective Bag by Mechanical Means—William Beauclerk, Irvington, N. J., to Pure Maid Products Co. No. 2,037,362. April 14, 1936.

Cream Treated to Make Butter Fat Globules of Uniform Size and Tempered to Increase Viscosity Conducive to Whipping—Joseph Willmann, Derby, Conn. No. 2,037,405. April 14, 1936.

Green Corn Husking Machine — Floyd A. Knight, Cedar Rapids, Ia., to Food Machinery Corp., San Jose, Calif. No. 2,037,661. April 14, 1936.

Doughs Twisted by Mechanical Means—Charles J. Kummer, to Sheboygan Machine Co., Sheboygan, Wis. No. 2,037,985. April 21, 1936.

Yeast-Leavened Dough Mechanically Tested to Determine Critical Maturity Point—William L. Heald, one-half to Flour Mills of America, Inc., Kansas City, Mo. No. 2,038,044. April 21, 1936.

Licorice-Containing Confections Shaped to Imitate Smoking Pipe—Clarence M. Kretchmer, to American Licorice Co., San Francisco, Calif. No. 2,038,366. April 21, 1936.

Shelled Eggs Coated With Deposit of Calcium Carbonate, Mild Organic Acids, and a Light Film of Mineral Oil to Reduce Natural Porosity of Shell—Faw Yap Chuck, San Francisco, Calif. No. 2,038,540. April 28, 1936.

Ice Cream Sundaes Made Ready-to-Serve by Solidifying in Truncated Cone Form—Frederick Thomas Krein, Park Ridge, Ill., to Vortex Cup Co., Chicago, Ill. Nos. 2,038,575 and 2,038,576. April 28, 1936.

Finely Ground Apple Pomace Washed in Mixture of Alcohol, Acid and Water, Preliminary to Adjustment of Acidity, Drying and Standardizing of Dried Mass to Have a Predetermined Jelling Strength—Herbert T. Leo, Anaheim, Calif. No. 2,038,582. April 28, 1936.

Container for Food Prepared From Hull or Skin of Natural Fruit — Hubert A. McIlvaine, Cleveland Heights, Ohio, to the Continental Fruit Products Co., Frostproof, Fla. No. 2,038,584. April 28, 1936.

Rancidity Development in Oil-Containing Foods Inhibited by Flexible Packaging Material Having a Vegetative Anti-oxidant Surface—Sidney Musher to Musher Foundation, Inc., New York, N. Y. No. 2,038,752. April 28, 1936.

Hop-Flavored Beer Made From Prune and Malt Liquors—Eberhard A. Klepper, Paicines, Calif. No. 2,038,939. April 28, 1936.

Fish Cut Into Can Lengths and Put in Cans by Mechanical Means—Walter E. Rooney, Bellingham, Wash., to American Can Co., New York, N. Y. No. 2,039,350. May 5, 1936.

Prepared Cake Mixtures Packaged in Cans With Center Heat-Conducting Tubes to be Used as Baking Container—John N. Young, Brooklyn, N. Y., to American Can Co., New York, N. Y. No. 2,039,374. May 5, 1936.

Starch Produced From Wet Starch-Bearing Material—Albert Peltzer, Jr., Palo Alto, Calif., to Merco Centrigual Separator Co., Ltd., San Francisco, Calif. No. 2,039,605. May 5, 1936.

Lecithin-Containing Nutrients Prepared by Distilling Phosphatide-Water Emulsion With Sugar-Containing Material — Bruno Albert Rewald, Hamburg, Germany, to American Lecithin Co., Cleveland, Ohio. No. 2,039,739. May 5, 1936.

Metal Foils Having a Thickness of 0.005 to 0.03 mm. Used for Clarification of Beer—Rudolf Seibel, Dusseldorf-Oberkassel, Germany. No. 2,039,839. May 5, 1936.

Reamer Type of Extractor for Handling, Cutting and Juicing Fruits on a Production Scale—Harold F. Watkins, Oakland, Calif., to Watkins Fruit Machinery Co., San Francisco, Calif. No. 2,040,114. May 12, 1936.

Staling of Yeast-Leavened Bread Retarded by Use of ½ Per Cent of Xylose—Albert K. Epstein and Benjamin R. Harris, Chicago, Ill., to Standard Brands, Inc., New York, N. Y. No. 2,040,249. May 12, 1936.

Non-Liquid Foods Canned in Substantially Dry State by Sterilizing With Steam Under Pressure with Cans in Inverted Position Prior to Sealing—Charles O. Ball, River Forest, and Paul C. Wilbur, Oak Park, Ill., to American Can Co., New York, N. Y. No. 2,040,726. May 12, 1936.

Candy Made From the Non-Fibrous Constituents of Ground Rice and Malted Barley—Young S. Kang, Chicago, Ill., to Minerva L. Guthapfel, Sugarless Candy Co., Evanston, Ill. No. 2,040,943. May 19, 1936.

Milk or Cream Pasteurized and Degasified in a Three-Step Continuous Process — Thomas Edward French, Kingston, England, to the Aluminum Plant and Co., Ltd., London, England. No. 2,041,059. May 19, 1936.

Biscuits Baked on Traveling Oven Band With Meshlike Openings Loosened From Bands While Warm and Soft by Mechanical Means—Robert Savy, Courbevoie, France, to Baker-Perkins Co., Inc., Saginaw, Mich. No. 2,041,091. May 19, 1936.

Cereal Foods Prepared With Wheat Germ as a Major Ingredient to Contain More Than Ten Times the Vitamin Content of Whole Grain—Charles Hoffman, Crestwood, N. Y., to Ward Baking Co., New York, N. Y. No. 2,041,129. May 19, 1936.

Fondant of the Hand-Rolled Cream Type Made From About 80 Parts Dextrose, 20 Parts Sucrose and Invert Sugar and 0.4 to 1.0 Parts Pectin—Albert Adams Lund, Port Washington, N. Y., to California Fruit Growers Exchange, Los Angeles, Calif. No. 2,041,197. May 19, 1936.

Milk Pasteurized and Cooled in a Compartment Heat Exchanger Under Thermostatic Control—Edwin Prestage, London, England. No. 2,041,483. May 19, 1936.

Miscellaneous Publications

DUST EXPLOSIONS DURING FIRE FIGHTING. By David J. Price, Chemical Engineering Division, Bureau of Chemistry and Soils, Washington, D. C. 1936. 9 pp., 5¾x9⅛ in. Price, 5 cents; obtainable from Superintendent of Documents, Washington, D. C.

Known as Circular No. 385, U. S. Department of Agriculture, this booklet emphasizes the dust-explosion hazard existing in grain elevators, flour and feed mills, starch factories and cocoa, malt, powdered milk, and similar food product plants as well as in those of other dust-producing commodities. Causes of dust-explosions and methods of preventing them are classified and discussed.

ALMANAC OF THE CANNING INDUSTRY. Published by *The Canning Trade*, 20 South Gay St., Baltimore, Md. 1936. 226 pp., 6x9 in., paper. Price, $1.

For 21 years this compact reference book of statistics, prices and other data for the canning industry has been published as a supplement to *The Canning Trade*. Such information is not easily found except in this compilation.

THE EXECUTIVES' INSTITUTE FOR APPLIED ECONOMICS. Published by National Industrial Conference Board, Inc., 247 Park Ave., New York, N. Y. 1936. 24 pp. 5⅝x8⅛ in. paper.

Announcing the formation of a new division of the National Industrial Conference Board, this booklet reviews the origin, growth, purpose and future plans of the N.I.C.B. and explains the need for, the purpose of, and the operation of the Executives' Institute.

AIR CONDITIONING FOR COMFORT. SECOND EDITION. By Samuel R. Lewis. Published by Keeney Publishing Co., 6 North Michigan Ave., Chicago, Ill. 1935. 277 + VII pp., 5¾x8⅜ in. cloth, illustrated. Price $2.50.

Although discussing comfort air conditioning for use in offices, theatres, and residences, the chapters on terminology, formulas and methods, psychometric tables and charts, humidifying and dehumidifying are helpful to one wishing to familiarize himself in a popular way with the rudiments of air conditioning. These fundamentals apply equally to industry.

FOREIGN COMMERCE YEARBOOK. Published by Bureau of Foreign and Domestic Commerce, Washington, D. C. 1935. 386 pp., 6¼x9¼ in. Cloth. Price $1.25; obtainable from Superintendent of Documents, Washington, D. C.

After a lapse of a year, the U. S. Department of Commerce has revived this yearbook with the addition of statistics of bankruptcies and protested notes as well as increased use of value figures for agricultural and industrial production. The former gold dollar is generally used as a basis for the conversion of foreign trade statistics.